SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 19, 1905.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

SCIENTIFIC SURVEYS OF THE PHILIPPINE ISLANDS.

MESSAGE FROM THE PRESIDENT OF THE UNITED STATES.

To the Senate and House of Representatives:

Circumstances have placed under the control of this government the Philippine Archipelago. The islands of that group present as many interesting and novel questions with respect to their ethnology, their fauna and flora, and their geology and mineral resources as any region in the world. At my request, the National Academy of Sciences appointed a committee to consider and report upon the desirability of instituting scientific explorations of the Philippine Islands. The report of this committee, together with the report of the Board of Scientific Surveys of the Philippine Islands, including draft of a bill providing for surveys of the Philippine Islands, which board was appointed by me, after receiving the report of the committee appointed by the National Academy of Sciences, with instructions to prepare such estimates and make such suggestions as might appear to it pertinent in the circumstances, accompanies this message.

The scientific surveys which should be undertaken go far beyond any surveys or explorations which the government of the Philippine Islands, however completely self-supporting, could be expected to make. The surveys, while of course beneficial to the people of the Philippine Islands, should be undertaken as a national work for the information not merely of the people of the

Philippine Islands, but of the people of this country and of the world. Only preliminary explorations have yet been made in the archipelago, and it should be a matter of pride to the government of the United States fully to investigate and to describe the entire region. So far as may be convenient and practical, the work of this survey should be conducted in harmony with that of the proper bureaus of the government of the Philippines, but it should not be under the control of the authorities in the Philippine Islands, for it should be undertaken as a national work and subject to a board to be appointed by Congress or the President. The plan transmitted recommends simultaneous surveys in different branches of research, organized on a cooperative system. This would tend to completeness, avoid duplication, and render the work more economical than if the exploration were undertaken piecemeal. No such organized surveys have ever yet been attempted anywhere, but the idea is in harmony with modern scientific and industrial methods.

I recommend, therefore, that provision be made for the appointment of a board of surveys to superintend the national surveys and explorations to be made in the Philippine Islands, and that appropriation be made from time to time to meet the necessary expenses of such investigation. It is not probable that the survey would be completed in a less period that that of eight or ten years, but it is well that it should be begun in the near future. The Philippine Commission and those responsible for the Philippine government are properly anxious that this survey should not be considered as an expense of that government, but should be carried on and treated as a national duty in the interests of science.

THEODORE ROOSEVELT.

THE WHITE HOUSE,
February 7, 1905.

REPORT OF THE COMMITTEE OF THE NATIONAL ACADEMY OF SCIENCES.

1. *Need for Comprehensive Work.*—The primary incentive to scientific exploration of the Philippine Islands, as of any other region, is a desire to promote the commercial and industrial welfare of the inhabitants, and this purpose should never be lost sight of. Experience shows that this end is best attained by a comprehensive investigation of facts and conditions undertaken in a broadly scientific spirit. Millions of dollars have been spent in searching for coal in regions where the rocks are far older than the coal measures; it was the seemingly unpractical science of paleontology which put a stop to this waste and enabled geologists to outline the areas to which valuable coal fields are limited. So, too, antiseptic surgery is an application of recondite branches of botany and chemistry. The vast benefits which the Agricultural Department and the Fish Commission have conferred upon our country are founded upon the untiring labors of zoologists, botanists and chemists whose sole purpose was to elucidate the truth; and long after Franklin took the first step in the science of electricity economic applications of the knowledge acquired were almost undreamed of. In short, modern industrial development is an outgrowth of pure science, and almost every discovery of science is ultimately turned to economic account. Hence it would be short-sighted not to extend to the Philippines the broad and generous spirit of research which animates the governmental scientific work of the United States.

The main object to be sought in planning explorations of the Philippines is not to suggest new or unusual subjects of study or methods of study, but to provide against duplication of work, and to arrange for such cooperation between the officers engaged in different branches of the Scien-

tific Surveys as will insure rapid, satisfactory and economical progress in a noble contribution to human knowledge.

Since the United States is engaged in the first serious attempt to develop an Anglo-Saxon civilization in the tropics, and among a non-Aryan people, it may not be amiss to call attention to the effect on the enlightenment and culture of the Filipinos which systematically undertaken scientific surveys must inevitably produce. Such explorations will be a practical lesson in the application and value of learning.

2. *Resources of the Islands.*—The Philippine Islands form an extreme portion of one of the most interesting areas in the world, viz., Malaysia. The archipelago lies along the edge of the great and permanent abyss of the Pacific Ocean, forming the last bulwark of the Asiatic continent towards the southeast. This geographical position, half-way between Japan and Australia, with the China Sea on one side and the Pacific on the other, is most favorable to the development of a great commerce, which, indeed, the Philippine Islands once enjoyed.

The archipelago has not always been separated from Borneo, Java, Sumatra and the Peninsula of Malacca; on the contrary, land connections throughout this area existed at various times in its geological history. It is also probable that at one time Luzon and Formosa were connected. The islands themselves have undergone many geological vicissitudes, still indicated in part by the belts of extinct and active volcanoes which intersect them.

Gold veins, seemingly of very ancient origin, are widely distributed in the islands, though no great gold field is known to exist there; and there are some valuable copper deposits. The Philippines contain also important deposits of mineral fuel similar to the so-called coals of Japan and Borneo—a good quality of lignite—upon which much of the industrial development of the islands must depend. It is well known that the fertility of the Philippines is astonishingly great. This is due primarily to a favorable admixture of various igneous rocks with limestones and sandstones. In the moist and equable climate of the archipelago the rocks are rapidly converted into soil, while the absence of cold and drought results in a vigorous growth of roots, which protects the soil, as soon as formed, from rapid erosion by the heavy rains. One evidence of the fertility of the land is the presence of superb hardwood forests. These have been estimated to cover at least a third of the area of the islands, or, say, forty thousand square miles, and they include nearly two hundred species of valuable timber trees. All tropical crops will grow in the Philippines, while that very important plant (*Musa textilis*) which yields the so-called manila hemp, flourishes best in the archipelago. The resources of the islands have been very imperfectly developed; indeed, under Spanish rule, attempts at industrial progress usually met with disfavor. After the establishment of a well-ordered peace, the first step in progress must be the accumulation and dissemination of accurate and systematic information.

3. *Need of Coordination.*—In order rapidly and economically to provide the information desired, it is essential that the various branches of the work should be coordinated, for they are to a considerable extent interdependent; for example, topographical maps, which are an indispensable preliminary to geological mapping, are also required for planning highways, for military purposes, for the Land Office, for the Bureau of Forestry and for other ends.

It will be necessary in the Philippines, as elsewhere, to map some regions on a larger scale than others. Simple relations between the several scales used should be

maintained, as is done in the topographical mapping of the United States. In selecting the scale for any region the uses to which the map is to be put should be well considered and the survey made with an amount of detail adequate to the use in view. A naval station, an army post, or the location of a possible canal should be surveyed in greater detail than would elsewhere suffice. It seems entirely practicable to foresee the probable development of a system of highways, since these are largely controlled by natural conditions, and there is no reason why the development of means of communication should not be taken into consideration in the original surveys. The mapping of each area should thus be undertaken on such a scale as will suffice for the several purposes to which the government expects to apply the maps. Similarly, geological work should be done not merely with a view to elucidating the physical and biological history of the archipelago, or even to describing the mineral resources of the islands; the origin of soils, the occurrence of road metal and the facilities for or the obstacles to the cutting of canals, tunnels, or roads should be systematically reported upon from a geological point of view. Indeed it is manifest that assistance can and should be rendered by each branch of a complete survey to one or more coordinate branches. For this reason a plan of cooperation will be suggested somewhat later.

4. *Scope of Inquiry.*—The subjects which it is advisable for the government to investigate in the Philippines may be grouped as follows:

Coast and geodetic work and marine hydrography.
Land topography, including surveys and classification of the public land.
Geology and mineral resources.
Botany.
Problems of forestry.
Zoology.
Anthropology.

All of these subjects may be embraced under the general term scientific explorations, and their study may be carried to a satisfactory degree of completion in a few years.

Several other lines of inquiry are omitted from the enumeration, although they also are of great importance in the economic development of the islands. They are chiefly of local interest, and are largely administrative, but are permanent in character. They include meteorology, sanitation, the study of animal parasites, insect pests and the fungous diseases of plants, as well as sylvicultural and administrative forestry and the establishment of agricultural experiment stations and of zoological and botanical gardens. These lines of investigation have already been initiated and more or less fully provided for by the civil government of the Philippine Islands. The scientific surveys would naturally cooperate as far as possible with the insular scientific bureaus to the great advantage of both.

These several branches of the inquiry will furnish contributions to human knowledge, the importance of which will probably stand in the following order: Zoology, anthropology, botany, forestry, geology.

5. *Coast and Geodetic Work.*—The first step to be taken in the survey of the Philippines is the establishment of geographical stations and a primary triangulation. The position of Manila Observatory is of course well known, and many other points have doubtless been well determined, but the accuracy of existing determinations should be checked and the network completed. The land area of the archipelago is not large—only about 120,000 square miles—but because of its distribution in several hundred islands the area to be triangulated is far larger.

The importance of marine hydrography requires no emphasis further than to recall

the accidents and disasters which have occurred in the Philippine Islands since the American occupation for lack of adequate surveys and charts. It seems eminently desirable that, as fast as the triangulation is sufficiently advanced, a survey should be made of the very extensive shore line of the archipelago by a corps of marine hydrographers. These can determine better than topographers the amount of detail desirable in the line common to land and marine surveys. The line so determined should be accepted by both corps, and from it the hydrographers should work seaward and the topographers inland. The hydrographers will meet with especial difficulties on account of the innumerable coral reefs in the Philippine waters, and may also have trouble with recent uplifts, such as are alleged to have taken place within a few years in the Island of Paragua. There and elsewhere bench-marks should be established.

The Coast and Geodetic Survey has already begun work in the Philippines. It has occupied twenty-eight well-distributed astronomical stations, all in telegraphic communication with Manila, commenced a considerable number of harbor surveys, and initiated tidal observations at numerous points. It has also planned more extensive operations.

6. *Topography.*—Topographic work in the mountainous and wooded portions of the Philippines will be extremely difficult, the vegetation being so dense as to form an almost complete obstacle to vision and to free locomotion. However, in various portions of the archipelago, extensive open plains exist which can be rapidly mapped. It will probably be found that the native Filipinos will readily adapt themselves to topographical work, and, as they are extraordinarily agile, they will be of great assistance in the mountains and the forests. It is in the highest degree desirable that the surveys and subdivisions of the public lands should be committed to a topographical corps, such as that of the Geological Survey, as has been done, for example, in the Indian Territory. The topographical maps should show forest areas, but the discrimination of agricultural and mineral lands is not contemplated. As has been already noted, the scales employed should answer to the prospective uses to which the topographical maps are to be applied.

7. *Geology.*—The geological problems to be solved are numerous. The economic question of greatest moment is the stratigraphy of the coal-bearing Eocene formation, which is most extensively developed in southeastern Luzon (Albay and Sorsogon) and the Island of Cebu. It is probable, but not certain, that the coal deposits of Mindanao belong to the same period. The Eocene has been much disturbed and considerably faulted, so that its study will be a somewhat serious task. The coral reefs, volcanoes and earthquakes will necessarily also demand the attention of geologists.

The dense vegetation of the tropics offers great obstacles to the study of geology, and in the Philippines the lack of roads will also delay the work. There is, however, one set of exposures which are admirable and of vast extent, as well as readily accessible by proper means. It has been estimated that there are over eleven thousand miles of seacoast, without counting minor indentations, and along most of this line the rocks are exposed by wave action. The study of the geology of the country will probably proceed most rapidly if begun from boats along these coasts, and in beginning geological work on any of the smaller islands it will probably be expedient, as well as most economical, first to circumnavigate the island in steam-launches, mapping the exposures with care. With the information thus obtained it will be

comparatively easy to extend the surveys into the interior.

The geological formations of the East Indies, including Malaysia, are as yet imperfectly correlated with those of Europe. The distance separating these two regions is so great, and the intervening land mass with its peculiar mountain systems is so immense, as easily to account for extreme differences in fossil remains, rendering it difficult to correlate the two systems. On the other hand, in America, where the mountains and coasts have a southerly trend, formations can be followed from the temperate zone into the tropics with no great difficulty, and a definite correlation has thus been obtained. Hence it is advisable that the geologists, and especially the paleontologists, who may be sent to the Philippines, should have familiarized themselves with the geology of the marine strata of the West Indies and the Gulf of Mexico. In some respects knowledge of the geology of the tropics is of more importance in the elucidation of the earth's history than that of the temperate zone. Climatic conditions along the equator must always have been more equable than in the temperate zone, and the development of life must have been less affected by changes in local conditions. Hence near the equator, if anywhere, will be found evidence of variations in the climate of the earth as a whole in earlier geological times, variations such as may have been due to changes in solar emanation or in the composition of the earth's atmosphere.

Attention has already been called to the fact that geologists should systematically lend assistance in the study of soils and in the development of a system of highways.

8. *Zoology and Botany.*—The Philippines have long been an attractive field for the student of natural history, and some of the most important theories respecting the origin, distribution and coloration of animals and plants have resulted from studies in this region. It was chiefly from observations of the insects of the archipelago that Wallace discovered the law of natural selection independently of Darwin, who had not then published his 'Origin of Species.' But the fauna and flora are still very imperfectly known. Field work in ornithology has been more thorough than in the other lines; nevertheless, several of the larger islands have been only slightly explored, and some of the smaller ones not at all. A small collection of mammals made by a bird collector on Mount Data, in northern Luzon, comprising only such species as were brought to him alive by the natives, contained half a dozen new generic groups. This may be taken as a promise of what will be learned when the numerous lofty mountains of the larger islands are systematically explored. Heretofore most of the natural-history work has been along the coast and larger rivers. In future the most promising and important field, and also the most difficult so far as land species are concerned, is in the highlands of the interior.

The fauna of the Philippines is complex in origin and heterogeneous in character. It consists of types originally derived in part from the south (Borneo, Celebes and the Moluccas) and in part from the north (Formosa and southeastern China); hence it is not surprising that the animals and plants of certain islands differ widely from those of other islands. It is important that the fauna and flora of each island be studied in detail, and that the zoological work include mammals, birds, reptiles, batrachians, fishes, insects and marine invertebrates; and that the botanical work include, besides systematic botany, the study and identification of the food plants, fiber plants and medicinal plants used by the native tribes.

In each of these departments the work

should be under a trained naturalist, competent to supervise the field work, make the necessary technical studies and prepare the report relating to his own special line. The chief object of the work should be a complete and authoritative report on the fauna and flora of the islands, comprising descriptions of all the species, with a statement of their geographical ranges. This will lead to a natural classification of the islands according to the origin of the faunas and their relationship to one another and to those of adjacent islands. Attempts thus to group the islands have been made by Wallace, Steere, Worcester and others, but as yet the faunas and floras are too little known to admit of final judgment.

9. *Forestry.*—The subject of forestry in the Philippines is one which is both of deep scientific interest and of great importance in the economic development of the islands. A local bureau of forestry has already been instituted by the Philippine Commission, and this will undoubtedly be a permanent organization. It will be needed to protect, control and foster the extremely valuable timber resources of the islands, and it is already doing good work. There are, however, certain fundamental facts and relations in connection with the forests which can be ascertained only by a thorough scientific investigation, which is beyond the scope of the local bureau. These studies can be completed within a few years, with the certainty that the knowledge obtained will be of lasting benefit to the local bureau of forestry; and the investigation of these subjects properly belongs to a scientific survey of the archipelago. Such subjects are the sylvicultural organization of the forests; periodicity of growth in tropical trees; processes of seed-bearing, seed-distribution and germination; growth and competition in early life; the influence of moisture and temperature on the tropical forest and the influence of the forest on moisture and temperature. While forestry is, strictly speaking, a branch of botany, its methods are peculiar and it will be expedient to treat it as a separate branch of the scientific surveys.

10. *Anthropology.*—Although little is known of the archeology and ethnology of the Philippines, there are sufficient reasons for believing that, in these two closely related lines of research, facts of the greatest importance will be discovered in the archipelago. Indeed it is probable that in southeastern Asia or in the adjacent insular regions the remains of fossil man will be found. The discovery of bones of *Pithecanthropus erectus,* that strange ape-like man or man-like ape, in the Pliocene formation of the Island of Java, leads to the expectation that systematic research in the deposits marking the beginning of the Quaternary period in the Philippines will yield the remains and probably the works of man, and thus throw light on the subject of early man in Asia. The small amount of archeological research thus far accomplished in the islands has already revealed evidence of an apparently aboriginal people differing from the Negritos.

This Negrito race of the islands, with its closest affinities on the Malay Peninsula and the Andaman Islands, offers a problem of exceeding interest and scientific importance. Where did this Negrito race originate? Is it a distinct primitive type that has persisted in the outlying regions of the Asiatic continent? or is it a differentiated branch of a widely extended primitive race or species of man? These and other important questions may not improbably be answered by an extended anthropological survey of the Philippines.

Linguistic studies of the widest scope should be pursued on the islands. The myths and folk-lore of the various tribes should receive the attention now demanded by the requirements of science. Collections

of archeological material also should be secured as a means of studying the early status of man on the islands; and the effect that the later intrusions have had on the aboriginal peoples ought to be ascertained by a thorough study of the customs, arts and mental characteristics of the many and diversified tribes.

Knowledge of these matters is essential in order that the proper method of dealing with the natives may be determined. The honor of the United States demands that every means be taken to avoid mistakes of ignorance in dealing with the vast and relatively helpless population of these islands. This first attempt of the United States to bring alien races of the tropics into the fold of Anglo-Saxon civilization should be guided by strictly scientific data and principles. This necessitates, first, thorough knowledge of the peoples to be assisted, and then measures which accord with their various customs and their capabilities. Only a thoroughly scientific anthropological survey can provide the information required for the attainment of enlightenment and humane results.

11. *Collections and Their Disposition.*—Each special survey should cooperate as far as practicable with other branches of the service in the collection of specimens, and be ready to afford them all facilities not incompatible with its own efficiency.

The specimens collected will be the property of the United States. The first series, including all type specimens, should be deposited in the United States National Museum. A series of duplicates should be deposited in a local museum in the Philippines, such museum to be designated by the Philippine Commission. Other duplicates, if there be any, should be distributed to such leading museums, desiring collections of this character, as by reason of permanent endowments are able properly to care for and preserve the specimens.

12. *Comparative Studies in Adjacent Islands.*—For the purposes of the contemplated surveys Malaysia as a whole constitutes a convenient geological and biological province. A very large amount of valuable scientific investigation has been accomplished in other portions of Malaysia, particularly by Dutch geologists and naturalists. Some of the questions arising in the Philippines can not be satisfactorily settled without comparison of the occurrences in the archipelago with those in adjacent islands. Hence this committee is of opinion that general permission should be granted to the scientific surveys of the Philippine Islands to send observers, from time to time and for brief periods, to neighboring islands for the purpose of making comparative studies. Great saving of time and great increase in efficiency would result from such a provision.

13. *Administration.*—The scientific history of the United States during the last fifty years demonstrates the value of unification and systematic organization in such surveys as are contemplated in this report. The state geological surveys were manned by able and industrious observers, but there was a lack of unity of method and a lack of unity of aim, which made it nearly impossible to correlate their results. No one familiar with the subject will question the statement that the country as well as the science of geology has profited by the extension of the United States Geological Survey over the entire country. The national scientific bureaus have, laboriously and after long experience, developed methods of work and staffs of assistants which are at least equal to any in the world. To develop in the Philippines a separate set of similar bureaus would require much time and loss of time. Nor would employment in such bureaus be attractive; for prolonged service in the tropics is so trying to most constitutions that the number of

competent men willing to accept permanent positions there will probably not exceed the demand of the insular administrative bureaus to which reference has been made in a preceding paragraph. On the other hand, there seems no essential difficulty in embracing this area, like any other territory of the United States, in the fields occupied by existing national bureaus. Members of these organizations would be willing to be detailed for two or three years to so interesting a region as the Philippine Islands, with the prospect of resuming duty at home.

In order to secure cooperation and to preserve due proportions between the various surveys under the charge of the national bureaus, to arrange for suitable forms of publication of reports, prepare estimates, recommend legislation, determine upon the system of measurements, and to settle other questions of common interest, there must be frequent consultations in Washington between the representatives of the various branches of the work. For this purpose it is suggested that a board of Philippine surveys be created and put in charge of the work. It is manifestly of the utmost importance that such a board should be composed exclusively of eminent scientific experts, who alone are competent to direct the work. For administrative reasons it is essential that the board should consist of officers selected from the national scientific bureaus, and in the opinion of the committee these should be:

Superintendent of United States Coast and Geodetic Survey.

Director of United States Geological Survey.

Chief of United States Biological Survey.

Botanist of United States Department of Agriculture.

Chief of Bureau of Forestry.

Chief of Scientific Staff of Fish Commission.

Chief of Bureau of American Ethnology.

From these members one should be appointed chairman by the President, with the consent of the Senate, and the chairman should report to the President. There are precedents for such an organization in the Smithsonian Institution and in the boards of commissioners appointed to represent the government at various expositions.

The chief necessary expense of such a board would be a very moderate sum for clerical assistance; but it would probably be expedient and economical for the board to employ an officer, to be stationed at Manila, to perform functions analogous to those of quartermaster and commissary for all field parties, which will have many material wants in common.

While the methods of work and the selection of men should be left to the chiefs of the national scientific bureaus, viz., the members of the Board of Philippine Surveys, much latitude must be allowed the officers in charge of field work in so remote and exceptional a region as the Philippine Islands. On the other hand, if these officers are left entirely to their own judgment as to areas in which work is to be done in any given season, and as to the amount of detail requisite, there will be danger of lack of harmony in the results and delay in the progress of the work. To insure cooperation and to avoid duplication in the field work the following plan is suggested:

Let a scientific council be created in the Philippine Islands, presided over by a member of the Philippine Commission, to consist of the chief field officers of the several scientific bureaus present in the islands, as follows:

One geodesist, designated by the superintendent of the Coast Survey.

One hydrographer, designated by the superintendent of the Coast Survey.

One topographer, designated by the director of the Geological Survey.

One geologist, designated by the director of the Geological Survey.

One zoologist, designated by the chief of the Biological Survey.

One botanist, designated by the botanist of the Department of Agriculture.

One forester, designated by the chief of the Bureau of Forestry.

One anthropologist, designated by the chief of the Bureau of American Ethnology.

with whom should be associated one officer of Engineers, U. S. A., and one naval officer. Let this council meet once each year, for example, towards the close of the rainy season, and decide, in the interests of the Philippine surveys as a whole, what areas each bureau shall take up during the ensuing season, and with what degree of detail. It is believed that such a council would deal satisfactorily with all matters which might come before it, without lack of due regard to the expert opinions of the chief officers affected. In case of dissatisfaction, however, an appeal might be allowed to the governor-general. The findings of the council should be regularly reported to the Board of Philippine Surveys in Washington.

14. *Aid from Army and Navy.*—Except at the largest towns, it is seldom possible in the Philippines to obtain clothing or food such as Americans are accustomed to, and transportation facilities are very limited. For this reason it is recommended that the officers of the scientific surveys be granted permission to purchase supplies at military depots, such as army posts and naval vessels, and to avail themselves of opportunities of transportation on vessels attached to either service when such accommodation can be afforded without detriment to the military service.

15. *Cost and Time.*—This committee is not in a position to offer estimates of the cost of Philippine surveys. These could be easily furnished by the chief officers of the various scientific bureaus. It is believed, however, that with a moderate number of parties in each branch, under the system of cooperation recommended in this report, nearly all the work of exploration outlined above would be completed in a period of ten years, including charts, topographical maps and geological maps.

16. *Order of Importance.*—Should it be impracticable to organize the entire system of surveys simultaneously, it is recommended that they receive attention in the following order:

Coast and geodetic work and marine hydrography.

Land topography, including surveys and classification of the public lands.

Geology and mineral resources.

Botany.

Systematic forestry.

Zoology.

Anthropology.

This report was adopted by the committee on February 7, 1903.

William H. Brewer,
Chairman.
George F. Becker,
Secretary.
C. Hart Merriam.
F. W. Putnam.
R. S. Woodward.

ANTHROPOLOGY AND ITS LARGER PROBLEMS.

Youngest in the sisterhood of sciences, anthropology borrows principles and methods from all the older branches of knowledge; and her first problem—a problem renewed with each step of advance and hence endless as the problem of quarry to the huntsman or of crop to the planter—is that of determining her own relations in the realm of knowledge, her own place and powers in the intellectual world.

Viewed in the light of history, it is no accident that anthropology is the youngest of the sciences; for it is the way of knowledge to begin with the remote and come down to the near—to start with the stars, linger amid the mountains, rest awhile

among rare gems, and only slowly approach such commonplace things as plants and animals and soils, to end at last with man. *How* growing knowledge has pursued paths leading from the remote to the near, from the rare to the common, from the abnormal to the normal, from the unreal to the real, from wonder to wisdom—indeed, from chaos to cosmos and from star to man—all this is history; *why* these paths have been pursued may well remain a problem until more is known of the constitution of the human brain and of the laws of mind.

Yet, viewed in the light of the relations among the sciences, it is no mere chance that the science of man rises from the hip and shoulder and head of the elder-sister sciences, as the family infant is borne by primitive folk; for the sciences have come up, just as the cosmos seems to have developed, in an order of increasing complexity. The stellar bodies are interrelated through gravity and various forms of molar force which may be combined under the term *molarity;* and astronomy in its earlier form was the science of these relations. As the planets took shape (whether through nebular integration or through planetisimal aggregation) chemical reactions became paramount over mechanical relations, and *affinity* was superadded to molarity; and in a parallel order chemistry was added to astronomy in the growth of knowledge. When our planet was encrusted and the great deeps were divided into sea and land, life appeared; and thereby *vitality* was superadded to affinity, and, concordantly, as knowledge grew, the biotic sciences followed the more exactly quantitative earlier branches. In cosmic time animal activity followed hard on more inert vegetal life, and *motility* was superadded to vitality; and in human time animals were domesticated soon after plants were cultivated, while zoology grew up nearly apace with phytology. As the earth aged into continental and seasonal steadiness and the struggle for organic existence grew strenuous, more and more of the battles were lost to the strong and the races to the swift, and were won by the intelligent, and thereby *mentality* was superadded to vitality as a factor in earth history and man came to his own as a mind-led monarch over lower life and a progressive conqueror of the natural forces; and in like manner, as human history matures, it records anthropology as the younger-kin of zoology. In a word, man, as the head and intellectual ruler over the realm of life, alone stands for all the fundamental forces of molarity *plus* affinity *plus* vitality *plus* motility *plus* mentality, and is interrelated alike with sun and planet, agent and reagent, plant and seed, egg and animal, and with groups of his own kind; and in a word, the science of man is, more than any other branch of knowledge, interdependent with all the sister sciences and more many-sided than any of the rest.

THE SETTING OF THE SCIENCE.

The scriptless nomads of the human prime (and of many lands) set their journeys by the stars and enshrined their beastly deities in the visible firmament, and thus astrology set out on a course still traceable through constellations and planet-myths; at the same time these mnemonic devices of the sky were mated with equally imaginative symbols of every-day things, and as these grew into geometric designs and arbitrary characters, a system of almacabala—the earth-placed twin of sky-set astrology—took a course still marked by the ancient hieroglyphs of many lands. In the fulness of time (and primitive progress was tedious beyond telling) astronomy grew out of astrology as the first of the sciences, leaving a large residuum of mythology behind. In like manner, and at about the same stage (*i. e.*, about the birth-

time of writing), algorithm and algebra came out of almacabala, leaving a residuum of black art and white magic, jugglery and enchantment; and as the algorithm grew into arithmetic and wizardly geomancy gave way to scholarly geometry, mathematics took shape as the complement of astronomy—and these sisters twain were nurses and teachers of all the younger sciences. Still the caldron of inchoate knowledge boiled and bubbled with Macbethian pother, and the foul fumes of black magic long concealed the few germs of real knowledge shaped by the steady pressure of actual experience—for this was the time of alchemy, whose slimy spume at last slipped away from chemistry, the third of the sciences.

Astronomy led writing (as the constellations attest), while mathematics followed close on writing and records as its symbols show, and both belonged to what may be called the naissance of knowledge; chemistry appeared during the same period, bearing the prophecy of physics caught by Archimedes, yet remained a helpless weakling—the foil and puppet of medievalism—throughout the whole of the dark ages; but during the renaissance the trio of elder sciences gained strength together and assumed lasting dominion over the realm of knowledge. Because their birth dates back to or beyond the beginning of records, the early stages of these sciences are imperfectly written; but the youngest science, anthropology, buys methods and principles from the more exact elders and pays amply in coin of history—for by tracing the careers of later-born or slower-grown folk and cults, anthropologists learn to retrace the lost steps in the careers of ancestral peoples and early cultures. Here lie some of the relations between anthropology and the elder sciences; she receives exact methods tested by millenniums of experience, and gives interpretations of the ideas and motives, the arts and accomplishments, the modes of thought and the stages of progress of the earliest science-makers. Astronomy and mathematics and chemistry are systems of knowledge produced by men and minds, anthropology is systematic knowledge of these producers; and neither the old sciences nor the new can be rendered complete and stable without the support of the others.

The science of sentient man—of man as a thinking and collective organism—helps to illumine the dark ages no less than the naissance of knowledge; and at the same time it sheds new light on the origin of that group of modern sciences of which it is itself the youngest. The early period of intellectual activity in Babylon and Alexandria, Athens and Rome, may be likened to the blossoming of a plant in spring-time; it was the summing and outshowing of a mentality shaped during uncounted generations of experience along definite lines, in environments of distinctive sort—and the blossoming was fuller of promise than the ancients dreamed. Then came the ages that were dark because energy was diverted to new lines; for leaders of thought gave way to leaders of action, and these became pioneers in new environments where threads of new experience had to be spun from the lives of generations before they could be woven into the fabric of knowledge. The forefathers of the joint founders of scholasticism and science lived winterless lives in sunny lands, and the early science reveals an elysian tinge; while the ancestry of the makers of modern (or natural) science spent their force in conquering woodlands and wood-life in cloudy and wet and long-wintered Europe, and their efforts finally yielded a harder and more practical product than that of the earlier and easier time. During the nature-conquest of a millennium and more, the ideals of the elder masters seemed lost in a

survival of astrology and alchemy, a survival so well recorded in growing literature as to simulate a revival; yet the sense of the reality of things gained strength by exercise in the ceaseless contact with nature, while the oft-told magic was relegated to beldams and crones rather than reserved for rulers and high-priests as of old. The Renaissance revealed the influence of these centuries of nature-conquest and nation-planting which made the Europe of history; and its dawn showed that the seat of highest intellectual activity had slipped in the darkness from the sensuous shores of the eastern Mediterranean to the remote and rugged lands in which the world's richest blood and ripest culture were blent and pent against northern seas. The closest concentration of human strength was in Britain, the uttermost goal of conquest, the last resting-place of the conquerors of conquerors, where Cæsar might have wept for worlds like Alexander long before; and here modern science began with Francis Bacon (1561–1626) as expounder. The Britainian Renaissance coming so long after the Mediterranean Naissance may be likened to the ripe-fruiting of a plant in autumn; for it followed the vernal blossoming after a tedious interval of scarce-seen growth.

With the 'Novum Organum' of Bacon, the last vestige of magic and mysticism fell away from the body of real knowledge; for not only was the practicality of centuries summed in the new system, but its author saw more clearly than any predecessor the relation between the thinker and his thought, between the human mind and the rest of nature—he perceived that 'Man * * * does and understands as much as his observations on the order of nature * * * permit him, and neither knows nor is capable of more.' On this and kindred verities he built a foundation for all the sciences, for the unwittingly-wandering elders as well as for those yet unborn, even down to anthropology—though this part of the foundation lay unused for three centuries. Bacon's influence on contemporary and later thought was steady, albeit slow-felt; for his school was a normal by-product of the making of Europe, and he was the exponent of principles themselves the product of the world's most significant chapter in human development. True, the next epoch was opened by a son of southern shores and a devotee of the oldest science when Galileo (1564–1602) saw the sun-centered order of the solar system; yet it was left to English Newton (1642–1727) to shape the epoch and systemize all astronomy by a law of gravitation based on commonplace observation, while the third epoch of modern science came with Linné (1707–1778), like Bacon and Newton a product of the harsh northland and an exponent of practical experience, who led conscious seeing down from the stars to the plants and animals of daily knowledge. Of all the world's thinkers Linné would seem second only to Bacon in originality, if that quality be measured by grasp of realities; and while his system was crude, especially in relation to animals, his gift of phytology (or botany) enriched knowledge and opened the way for the rest of the natural sciences. Linné, the Swede, was soon followed by Hutton, the Scot (1726–1797), with a practical science of the rocks long contested by Werner, the German (1750–1817), under a theory smacking of Alexandria and Athens; but the sturdy English quarryman, William Smith (1769–1839), successfully supported his northern neighbor until his countryman, Lyell (1797–1875), came up to make geology a science. The influence of these sons of woodland and wold extended rapidly and widely, rooting readily in the fertile minds of their kinsmen, while the printing-press spread the stimulus of their work over all Europe

and unified the knowledge of the nations.

The next act attested the blending of the ancient and the modern, of Athenian and Anglican, of Aristotelian and Baconian, of the southern and the northern, and the scene was the middle ground of France. There Lavoisier (1743–1794) applied modern practicalness to chemistry, and discovered the indestructibility of matter; Lamarck (1744–1829) sought to amend the Linnean system, yet pushed too far in advance of observation (and his times) for full following; and the brothers Cuvier (1769–1838) so improved on Linné as to give form and substance to zoology, and incidentally to presage anthropology. These movements led up to the distinctively nineteenth-century stage, and a renewed pulse of British activity; Joule and others measured the mechanical equivalent of heat and experimentally demonstrated the persistence of motion, and so founded physics; by masterly observation and comparison, Darwin defined the development of species (including man), thus infusing the blood of life into the Linnean system; Huxley and Tyndall simplified all science by establishing the uniformity of nature; and at last American scions of Anglican sires independently discovered through anthropologic observation that the minds of all men of corresponding culture-grade respond similarly to similar stimuli, thereby proving the soundness and completeness of the Baconian foundation of knowledge. The four laws of nature established in western Europe—the indestructibility of matter, the persistence of motion, the development of species and the uniformity of nature—are, in fact, complementary to the law forecast by Bacon and applied in America three centuries later as the responsivity of mind; and the five laws are the cardinal principles of science. It is curious that while Bacon's view of the mind as a faithful reflex of other nature colored and shaped the progress of science through the centuries (for how could Lavosier, or Joule, or Darwin, or Huxley repose confidence in their observations without resting even greater confidence on the accuracy of the observing mechanism?), the Baconian law lay in the background of thought without conscious expression (despite daily subconscious use) from the dawn of the seventeenth century down to the last quarter of the nineteenth. *How* the law was neglected is the history of modern science read between-lines; *why* it was neglected until the science of sentient man arose to rediscover it is a present problem for those anthropologists whose sympathies and interests cover the full field of human knowledge.

Howsoever the three-century eclipse of Bacon's fundamental law be interpreted, the history of science stands out sharp and clear when viewed in the light of anthropology: There were two great movements, the naissance in the east Mediterranean region, and the renaissance commonly credited to the Mediterranean countries but really made in the North Sea region; each comprised a long interval of accumulation of experience and a briefer time of formulation of knowledge; in each the formulated knowledge faithfully expressed the habits and characters of leading thinkers of the times; and the modern movement reached the commonplace thing of every-day life in such wise as to render science a devoted handmaid rather than a remoter deess, a means of welfare rather than an end of aspiration. The anthropologist feels that the comprehensiveness of the ancient and the practicalness of the modern unite in his science, which (despite the narrow definitions of earlier decades) is that of mind-controlled man, the dominant power of the visible world, the science-maker as well as the subject of science.

Such are a few of the relations of anthropology to the sister sciences, a few of

the ways in which the science of sentient man touches the sum of human knowledge; to catalogue all would be an interminable task.

THE RISE OF ANTHROPOLOGY.

When the science of man grew up in the North Sea region, it was at first little more than a branch of zoology, and its makers busied themselves with features of the human frame corresponding to those of lower animals; comparative anatomy was cultivated with assiduity and profit, anthropometry flourished, and mankind were apportioned into races defined by color of skin, curl of hair, slant of eyes, shape of head, length of limb, and other structural characters—*i. e.*, the methods and principles of zoology were projected into the realm of humanity. It was during this stage that homologies between human structures and those of lower animals were established in such wise as to convince attentive students that mankind must be reckoned as the ennobled progeny of lower ancestry; true, the conviction grew slowly against the instinctive antagonism of the investigators themselves and the less effective (though louder) protests of contemporaries, yet the growth was so sure that the question of the ascent of man is no longer a problem in anthropology. Meantime the masters—and here Huxley and Darwin must always rank—gave first thought to normal and typical organisms; their disciples followed the same commendable course, and as other lines of man-study opened they called their work physical anthropology. One of the collateral lines reverted to the abnormal (in which knowledge commonly begins) and recurved toward the Mediterranean (where the influence of Alexandria and Athens lingers still) to mature in criminal anthropology—the science of abnormal man; another line led through prehistoric relics to archeology, and still another stretched out to the habits and customs of primitive peoples, and eventually to comparison of these with the usages and institutions of civilized life. The last of these lines was laid out in Britain largely by Tylor, and was pursued in Germany and other European countries as general anthropology, ethnography, anthropogeography, etc.

Even before this growth began, a development not unlike that accompanying the making of Europe (save that the progress was more rapid) was under way in America; for the pioneers not only pushed out into their wilderness like their forebears of generations gone, but faced the novel experiment of life in contact with savage or barbaric tribes. To this new stimulus their vigorous minds responded promptly; the daily experiences were quickly flocked on distaffs of thought, spun into threads of knowledge, and duly woven into a web of practical science—a fabric no less independent in the making than that of Bacon in his day. Notable among the American pioneers was Albert Gallatin (1761–1849), statesman and scientist; he not only perceived, like his fellows, that the color and stature and head-shape of tribesmen were of trifling consequence in contrast with their actions and motives, but that the index to their real nature was to be found in what they habitually did; and he summed American experience up to his time in a preliminary classification of the native tribes on the basis of language. This advance marked an epoch in science no less important than that of Linné; true, it was not minted at a stroke nor finished without aid from others; yet Gallatin was the coiner, and the rough-stamped system was history's most memorable essay toward the scientific arrangement of mankind by what they *do* rather than what they merely *are*. Later Morgan (1818–1881) extended practical observation to the institutions of the aborigines in such wise as to found in-

ductive sociology;* and still later Brinton (1837–1899) made noteworthy advances toward classifying the Amerinds (*i. e.*, the native tribes) by their own crude philosophies, thus forecasting an inductive science now called sophiology. These advances seem simple and easy in the light of present knowledge, and may look small to present backsight; yet in originality of work and boldness of conception they rank with the advances of Linné and Lavoisier—and be it remembered that they were not borrowed in any part, but bought at cost of the sweat and blood of often tragic experience. The unprecedented practicalness of American anthropology is attested by the fact that while Morgan and Brinton still wrought (in 1879) a governmental bureau was created to continue the classification of the native tribes; and its direction was entrusted to Powell, a master able not merely to occupy, but greatly to extend, the foundation laid by Gallatin. Under this impetus the new science progressed apace; American students multiplied; observations spread afar; each discovery prepared the way for others, and the new principles opened to scientific view the entire field of the humanities—that field aforetime claimed on one side by scholastic and statist, and held on the other by devotees of poesy and romance. The growing knowledge bridged the seas and the Powellian product blent with that of Tylor (both profiting by the experience of British India), and pushed on to several continental centers during the last two decades of the nineteenth century.

Toward the close of the old century, what may be called the kinetic and collective characters of humanity were brought out clearly and the American aborigines (with other peoples as well) were defined by the *activities, i. e.*, by what they *do*, and this collectively—for in the realm of humanity no one lives to himself alone, but all are joined in twos and larger groups. Now it can not be too strongly emphasized that the basis of this definition differs fundamentally and absolutely from that of any other science; for all other entities—stars and planets, molecules and ions, minerals and rocks, plants and animals—are defined by what they *are* (perhaps measurably by the way in which they respond to external forces), while the humans are defined and classed by what they *do* spontaneously and voluntarily as self-moving and self-moved units or groups. Necessarily this view of humanity awakens inquiry as to why the human entity stands in a distinct class among the objects of nature; yet this is hardly a present problem, since the makers of modern anthropology find full answer in that unique nature-power lying behind the kinetic character of unit or group, viz., *mentality*. So in the last analysis the modern definitions of mankind are primarily psychic; and it matters little whether men are classed by what they *do* or by what they *think*, save that doing is humanity's largest heritage from lower ancestry and hence precedes thinking—the essential point is that the practically scientific classification of mankind must rest on a kinetic basis, *i. e.*, on self-developed and self-regulated conduct.

Of late the activities themselves are grouped as arts, industries, laws, languages and philosophies, and each group constitutes the object-matter of a sub-science, thus giving form to esthetology, technology, sociology, philology and sophiology; and these (together called demonomy, or principles of peoples), with somatology and psychology, make up the field of fin-de-siècle anthropology—the last two corresponding, respectively, with the physical

* The speculative sociology of Auguste Comte (1793–1857) and the semi-speculative system of Herbert Spencer are to be noted merely as standing on somewhat distinct bases.

anthropology of most European schools and the strictly inductive mind-science of current American schools, while the first two include archeology as their prehistoric aspects. These outlines and partitions of the groups are essential, although in actual interest they lie beneath the full fruitage of the field as a wire-hung skeleton lies below the sentient body athrob with vitality and athrill with consciousness of power over lower nature. This fruitage is too large and luxuriant for ready listing; it need now be noted only that, in the modern anthropology sometimes styled the new ethnology, the peoples of the world are not divided into races (save, perhaps, in secondary and doubtful fashion), but grouped in culture-grades, and that these culture-grades are of special use and meaning in that they correspond with the great stages of human progress from the lowly and unwritten prime to the brightness of humanity's present.

The culture-grades (and progress-stages) may be defined in terms of arts or of industries, of law, of languages or of philosophies, and the definitions will coincide so closely as to establish the soundness of the system, though it is customary to define them in terms primarily of law (or social organization) and secondarily of faith or philosophy. So defined the grades (and stages) are: (1) savagery, in which the social organization is based on kinship traced in the maternal line, while the beliefs are zootheistic; (2) patriarchy or barbarism, in which the law is based on real or assumed kinship traced in the paternal line, and in which belief spreads into pantheons including impressive nature-objects as well as beasts; (3) civilization, in which the laws relate mainly to tenure of territorial and other proprietary rights, while the philosophies grow metaphysical and the beliefs spiritual; and (4) enlightenment, in which the law rests on the right of the individual to life, liberty and the pursuit of happiness, and in which the philosophy is scientific or rational, while the faiths grow personal and operate as moral forces. The peculiar excellencies of this classification lie in its simplicity, and in the fidelity with which it reflects the unique nature-power lying behind the kinetic character of the human entity, *i. e.*, mentality; for, in the last analysis, the stages but portray and measure the normal growth of knowledge. Thereby the system sets milestones in the path of human progress, in numbers sufficient to outline its trend with satisfactory certainty; and it is especially notable that this trend is from the lower toward the higher with respect to every distinctively human attribute.

So anthropology came up, chiefly on the western hemisphere and under the stimulus of unique and strenuous experiences; and so it has assumed form and substance and spread widely over the world during two decades past. Viewed from its own high plane, the growth of the science presents no puzzling problem; yet, since no mind leaps lightly from classification on a static basis (as in somatology and its parent zoology) to classification on a kinetic basis (as in demonomy), the modern aspects of the science are full of problems to some students.

PROBLEMS OF CLASSIFICATION.

While the essential characters of mankind reside in mind-shaped activities, it remains true that the mental mechanism is planted in a physical structure derived from lower ancestry by uncounted generations of development; and the problem as to the weight properly assignable to hereditary structural characters in classifying men and peoples remains, in many minds, a burning one. As an academic problem, this may be said to distinguish the new anthropology from the old, and to divide

the anthropologists of the day into opposing schools, one chiefly American, the other chiefly European; as a practical problem of applied science, it has already engaged the attention of the world's leading statesmen (most of them approaching it empirically under the law that doing precedes thinking) and, with such help as they have been able to secure from science, they have solved it to their satisfaction, and have declared in numberless constitutional and statutory provisions that red and black, if not yellow, men share with whites the potency (at least) of enlightened citizenship, and should be led and aided and educated toward that goal despite the handicap of heredity. Here the highest statecraft and the most advanced anthropology strike hands; the statesman argues from his own experience that lowly men may be raised up, and hence that it were heartless to strike them down; the scientist but sums more numerous observations when he traces the upward trend of humanity; and both stand firmly on the rock of experiential knowledge. True, practical questions involved in the general problem are constantly arising: Can the Apache at San Carlos best be led toward citizenship by penalties for misdeeds, by rewards for righteousness, or by a combination of the two? Does the hereditary structure of the Negrito of interior Luzon debar him from hope of free citizenship, including that rectitude of conduct and nobility of impulse which free citizenship requires? Can the fellahin of Egypt be lifted from the plane of subjection to despotism to that of intelligent loyalty as royal subjects? Will the educational qualification in Maryland elevate the franchise? These are among the multifarious and ever-rising questions involved in the problem; and while the old anthropology stands aloof, they are receiving yearly solution at the hands of modern science and modern statecraft. Fortunately, this present problem of anthropology is no less practical than were those confronting pioneer Puritans and Cavaliers in an earlier century, and like those it must be wrought out through living experience; still more fortunately, the chief factors in the problem are now grasped by students taught in the severe school of the settlers—grasped so firmly that little remains undone save the bringing up of loiterers who linger in the haze of half-knowledge and harken idly to bookish echoes of simpler science.

Connected with this problem is another no less burning: Does the mental mechanism of mankind react on physical structure in such wise as to control the development of individuals and types? As an academic problem this is well-nigh lost in the dust of ill-aimed discussion (relating to the hereditability of acquired characters and a dozen other points) which it were indiscreet to stir; yet half an eye can see that, whatsoever pedagogues proclaim, the pupils are building bone and muscle, increasing strength and stature, and manifestly promoting brain-power and prolonging life by judicious regimen. As a practical problem this might be passed over, since the world's leading millions are so well advanced in doing that thinking may be trusted to follow duly (perchance soon enough to let the masters learn the lessons their pupils live), were it not for the ever-rising ancillary questions as to rate and trend of the progress. Thus, mean length of life, or viability, is increasing, especially among more advanced peoples, who live longer in proportion to their advancement; yet, although Mansfield Merriman computed a few years ago that the median age of Americans has gone up five years since 1850, while the twelfth census reported that our mean age of death had advanced from 31.1 years to 35.2 years in a decade, it can not be said that the rate of increase is known—and still less are the factors of

increase (saving of infants, improved sanitation, bettered hygiene, shortened hours and intensified stress of labor, enhanced enjoyment of life, and all the rest) susceptible of statement in terms of definite quantity. The various questions of viability (than which no inquiries mean more to living men) are not to be answered through actuaries' tables based on selected classes, valuable and suggestive as these tables are; they must be answered through health offices and census bureaus—and their pressing importance forms one of the strongest arguments in support of permanent census bureaus in this and other countries. Thus, again, human strength is increasing, as suggested by the superior vigor and endurance found among advanced peoples and rising generations, and shown definitely by the constant breaking of athletic records; yet, while it is most significant that record-breaking progresses at an increasingly rapid rate (*i. e.*, more records are broken during each decade than during the last), the rate of increase remains problematic. Similarly, that measure of faculty expressed in coordination of mind and body is increasing, as shown by the ever-growing and never-failing ability of engineers, mechanicians, builders, electricians and other specialists to master and command the strength-trying devices of modern times—locomotive and marine engine, dynamo and steam hammer, range-finder and machine-gun, and all the rest; yet both the rate and the factors of increase in human faculty remain in the realm of the unmeasured. These are but sample questions ancillary to the practical problem as to the reaction of function on structure; they merely suggest ways in which mind born of body in humanity's prime is rising into dominion over fleshly organ and constitution, as well as over subhuman nature—and these ways remain for the future to trace.

A related problem, although minor in itself, has recently risen into prominence through the impetus of importation oversea; it is that of 'degeneracy.' The observational data for the idea of human retrogression are apparently voluminous (though seen to be mainly of opposite meaning in the light of modern human knowledge) and the notion is by no means new; but the ratiocinative basis of the recent fad is obviously chaotic, *e. g.*, in that an individual is classed as 'degenerate' by reason of the inheritance of ancestral characters, or in other words, because he is no better than his sire or grandsire. True, if normal man is rising to successively higher planes of physical and mental perfection through constructive exercise, as modern anthropology so clearly indicates, the unfortunate who is no better than his ancestry is indeed below his proper place in the scheme of humanity—though not degenerate, but merely unregenerate (in non-ecclesiastical sense). It is also true that maleficent exercise may produce cumulative and apparently aberrant effects, just as does the beneficent exercise normal to mankind, the one yielding Nero and Billy the Kid as the other Shakespeare and Bacon, twin luminaries in intellectual history; but its end is destruction, with the consequent elimination of the criminal, while its middle merely marks lower layers in the constantly ascending stream of humanity. Naturally a theme filling tomes and flooding lighter literature for years is too large for full analysis in a paragraph; it must suffice to note that the 'degeneracy' of the day was not unfitly characterized even so early as when aphorism foreran writing, and the proverb beginning 'Put a beggar on horseback' gained currency. The great facts are (1) that less vigorous individuals fall short of the mean progress of their fellows in such wise as to get out of harmony with the institutions framed by

their leaders, and (2) that less vigorous peoples fall behind contemporary lawmakers in such wise that their institutions are inferior to those of progressive nations; while under the conditions of modern life laggards and leaders commingle so freely that the differences are emphasized and kept in mind. Nor are these differences slight or meaningless; they touch the very fiber of living and being so deeply that primal savages can not share the thought of those in any higher culture-stage, that barbaric serf and despot are wholly alien to subjects and citizens, and that subjects are out of place among citizens. So every advanced nation has its quota of aliens through foreign or ill-starred birth and defective culture, who can be lifted to the level of its institutions only through a regeneration extending to both body and mind, both work and thought—they are the mental and moral beggars of the community who may not be trusted on horseback, but only on the rear seat of the wagon. In truth, standards are rising so rapidly that the lower half find it hard to keep up.

In one aspect the problem of the unregenerate is ever pressing, since knowledge is not yet a birthright (save in the promising germ of instinct) among human scions of lower ancestry; but even in this aspect a progressive solution is wrought with ever-increasing success through public education. The most serious side of the problem arises in the immigration or upgrowth of the unfit, who sometimes ferment in the unwholesome leaven of anarchy before education has time for perfect work; and this danger cries out for public action through the blood of both presidential and monarchical martyrs to public duty. The morbid view imported by Nordau and his ilk demands little American notice, however large the problem in Europe; for under the stimulus of that personal freedom which is the essence of enlightenment, normal exercise of mind and body springs spontaneously, while hereditary disease, constitutional taint, idiocy, unhealthy diathesis, and all manner of transmissible abnormalities tend to wear themselves out, as our vital statistics sufficiently show.

These are a few of the present problems of anthropology involved in classifications growing out of the dual nature of mankind—the physical nature inherited from lowly ancestry and the mental nature (in all its protean aspects) built up through exercise during uncounted generations of functional development. They may seem irrelevant to that archaic anthropology which is content to define mankind by skulls of the dead; but they illustrate the living importance of that modern science which defines mankind by actions and thoughts, movements and motives.

MEANING OF ACTIVITAL COINCIDENCES.

About 1875 archeologists, and after them students of primitive folk still living, became impressed with certain similarities among industrial and symbolic devices of remote regions. One of the widespread devices is the arrow; used commonly with the bow, sometimes with the atlatl or throwing-stick, and again as a dart projected by the hand alone, it has been found on every continent and in nearly every primitive tribe. Another is a quadrate or cruciform symbol; either in the form of a simple cross or in that of the cross with supplementary arms known as the swastika or fylfot, these symbols are common to Europe, Asia, Africa, both Americas, and numerous islands, though they have not been found in Australasia. At the outset such devices were accepted as links in a chain of suppositious relationships, and as suggestions of common origin of both devices and devisers; but as observations multiplied, the hypothetic chain broke beneath its own weight, for the few similarities were gainsaid and

far outweighed by numberless dissimilarities of a sort manifestly attesting independent development. About 1880 Powell summarized the observed resemblances and differences among devices, and showed that the former are to be regarded as coincidences due to the tendency of the human mind to respond to contact with external nature in a uniform way. A dozen years later Brinton resumed the growing data and corroborated the Powellian conclusion; and on extending the inquiry to institutions, forms of expression and types of opinion and belief (in which the coincidences are even more striking than in the material devices), he formulated a theory of 'the unity of the human mind,' in which he saw a suggestion that the mind was extraneous in origin, *i. e.*, impressed on mankind from without—a view not unlike that long maintained by Alfred Russel Wallace. With the setting of the old century and the dawn of the new, the ever-multiplying facts were again reviewed, and the earlier generalizations were again sustained, but found to tell less than the whole story; for it was discovered that while minds of corresponding culture-grade commonly respond similarly to like stimuli, minds of other grades frequently respond differently—as when the savage eviscerates an enemy and devours his heart as food for courage, or the barbarian immolates a widow on the bier of her spouse, or the budding christian lends himself to the tortures of the inquisition, each reveling in his own righteousness and reprobating all the rest, though all are alike ghastly and obnoxious to enlightened thought. The new generalization rendered it easy to define the limits within which the responses of different minds to similar impressions may be expected to coincide; thereby it cleared away many of the anomalies and apparent incongruities among the observed facts, thus strengthening the law of activital coincidences as first propounded. The introduction of a limiting term also rendered the law more specific; so that the sum of knowledge concerning the relations between mind and external nature may now be expressed in the proposition: *Minds of corresponding culture-grades commonly respond similarly to like stimuli.* By far the most important effect of the new generalization was the inevitable recognition of a cumulative mind-growth in passing from savagery to barbarism, thence to civilization, and on to enlightenment; for, in the first place, this recognition afforded a key to—indeed a full explanation of—the sequence of the culture-grades, while, in the second place, it showed forth the course of the world's mental development as a growth no less natural than that of tree or shrub, originating within, conditioned by external environment, and not derived from any extraneous source. Thus the generalization in 1900 of a quarter-century's observations on mankind brought empirical knowledge to the theoretical plane so masterfully projected by Bacon three centuries before—for it was he who first grasped the great concept that mind is at once product and mirror of other nature.

Is the Baconian foundation for all science sound; is the most sweeping generalization of anthropology safe? This problem—for the two questions are but one—is the most important presented by the science of man, indeed by all science; for it threads the whole web of human knowledge, touches every human thought, tinctures every human hope, tinges every human motive. True, it is too large for easy apprehension, too round for ready grasp, but it spans the world's intellectual structure from corner-stone to dome, and must sooner or later be wrought out personally (as are all problems in the end) by each rational being.

PROBLEMS OF DISTRIBUTION.

Anthropology arose in Britain as a branch of biology fertilized by the doctrine of organic evolution; it grew up in a field of thought dominated by a tradition of human descent from a single pair and shaped by the habit of tracing nearer ancestry to the worthier sires in otherwise neglected lineage—and the coincidence of the doctrine of differentiation with revered tradition and honorable regard for honored sires led naturally to an assumption of monogenesis. The assumption spread and pervaded the writings and teachings of anthropologists trained in the biological school; it still prevails, and is still supported by the argument from biology, though Keane and others have balked at the corollary that wavy-haired white, kinky-haired black, straight-haired red, and variable-haired brown nestled in the same womb and suckled at the same breast. It is needful to note that the assumption, albeit perfectly 'natural,' is purely gratuitous, and that it is not sustained by a single fact in anthropology as a science of observed and observable actualities: the blacks are not growing blacker, the reds are not blushing redder, no new races are arising, no old types are increasing in diversity; Graham Bell's note of warning against the danger of a deaf race advertised a solitary definite suggestion of the formation of a new human type, though even this seems to weaken with the lapse of time; indeed, it can not be too strongly emphasized that, howsoever besetting and enticing the hypothesis of differentiation or diversification of *Homo sapiens* may be, it is absolutely without direct observational basis.

When practical anthropology arose in America, it was seen by Gallatin and Morgan and other pioneers that languages and social usages tend to spread among contiguous tribes; and as Indian students advanced it was perceived that the tendency toward activital interchange extended also to arts and industries and myths, and had, indeed, resulted in the development of powerful federations (somewhat miscalled 'nations'), such as the Iroquois League and the Dakota Confederacy. Meantime it was observed that the spontaneous interchange of words and weapons, usages and utensils, with contiguous tribes was sooner or later accompanied by intermarriage, so that blood and culture blent together. Of course this observation merely reflected the unwitting experience of every generation among every people in every land; but, made as it was under the stress of practical problems of polity and peace, it awakened consciousness—and the *law of convergent development* among mankind was grasped. Once realized, the law was found of wide application; it was perceived that black folk are not growing blacker, nor brown men browner, nor red tribesmen redder, but that (among other relations) some interchange of culture and blood begins with first contact and increases with time, until at least some of the leaven of the highest humanity pervades the lump, while the ideals and standards of all progress toward unity; it was perceived that the types of *Homo sapiens* (*i. e.*, the 'races' of mankind) are not differentiating, but bent by that irresistible mimetic impulse which is the mainspring of elevation especially among the lower and measurably among the higher; it was perceived that culture is fertilized by contact with other culture more effectively than in any other fashion; and it was perceived that when the initial differences are not too great, blood fertilizes blood in such wise that the vigor of a people may be measured by the complexity of their interwoven strains—that European yesterday and American to-day led and still lead the world because the blood of each streamed

up from a more varied group of vigorous sires than that of any earlier scion. The themes of culture-union and blood-blending are too broad and deep for treatment in a paragraph; yet it must be affirmed, with an emphasis which can hardly be made too strong, that these are the dominant factors of human development, and that this development, so far as actually observed, is always convergent, never divergent.

Now it is a logical corollary of the law of convergent development that mankind were originally more diverse than now, and hence that there must have been several *loci* or centers of human origin; and this corollary leads to a theory of polygenesis, which has been much discussed during a decade or two. Some of the polygenesists, like Keane, are content with four original stocks, corresponding, respectively, to the white, black, brown and yellow 'races' of mankind (leaving the red man, or Amerind, to be interpreted perhaps as a migrated branch of the brown stock); others, like Powell, find it easier to think of an indefinitely large number of initial stocks and centers of development from a hypothetic prototype to the 'human form divine'—a prototype represented, perhaps, in a particular place by the famous fossil from Java, the *Pithecanthropos erectus* of Dubois. The alternative hypothesis is that of the monogenesis assumed in the early days of man-science; and the choice—or adjustment—between these opposing views is one of the most prominent among the present problems of anthropology. The great facts are (1) that all known lines of human development are convergent forward and hence divergent backward, and (2) that all well-known lines of biotic (*i. e.*, sub-human) development are divergent forward; how these incongruous lines are to be united across the dark chasm of that unknown time when man became man remains a question, only made larger thus far by each advance of knowledge.

THE PROBLEM OF HUMANITIZATION.

To the comparative anatomist the gap between simian structure and human structure was of little note even before it was divided by the Dubois discovery in Java; for the differences between higher apes and lower men are less than those between either (1) lower and higher apes, or (2) lower and higher men. Yet to the sympathetic student of mankind these dead homologies are but unsatisfying husks—the great fact remains that even the lowest savage known to experience is human—man—in attitude, mien, habits and intelligence, while even the highest apes are but bristly beasts. It were bootless to deny or decry the chasm separating the always human biped from the always beastly quadrumane, since it is the broadest in the entire realm of nature as seen by those who appreciate humanity in its fulness. How the chasm was crossed, either in the one place and time required by monogenesis or in the many places and times demanded by polygenesis, is a question of such moment as to rank among the great problems of anthropology until (if ever) the solution is wrought. A tentative solution has, indeed, been suggested in the modified form of mating which must have attended the assumption of the erect attitude; yet final solution awaits the future.*

THE PROBLEM OF HUMAN ANTIQUITY.

So long as the assumption of monogenesis prevailed, the question of the antiquity of man loomed large in the minds of students, while even under the hypothesis of polygenesis the date (geological or historical) of advent of the earliest man is of no small interest. So the discussion of human an-

* 'The Trend of Human Progress,' *American Anthropologist*, Vol. I., 1899, p. 418.

tiquity has grown into dozens of full volumes, hundreds of chapters and thousands of special papers, not to include the tens of thousands of ill-recorded scientific utterances and literal millions of press items. This vast literature is not easily summed; it must suffice to say that the evidence seems to establish the existence of man in Asia and Europe and northern Africa during later Tertiary times, and thus before the glacial periods of the Pleistocene; but that the earliest Americans lagged behind, coming in probably before all the ice-periods closed, possibly nearer the earlier than the latest. Despite the wealth of literature, there is a woeful dearth of definite knowledge concerning the date or dates of man's appearance in different lands—and herein lies another of the present problems of anthropology.

Such are some of the larger problems of anthropology, that youngest science whose field touches those of all the rest. The special problems are legion: those of general sort are at once problems of science and of statecraft, of the daily life and welfare of millions, of greatest good to the greatest number. Fortunately all are such as to be solved by the slow but sure processes of observation and generalization; and it is especially pleasing to see—and to say—that these scientific processes are more steadily and successfully under way now than ever before. W J McGee.

SCIENTIFIC BOOKS.

Post-mortem Pathology: A Manual of Post-mortem Examinations and the Interpretations to be drawn therefrom. A Practical Treatise for Students and Practitioners. By Henry W. Cattell, A.M., M.D. Second revised and enlarged edition. Philadelphia and London, J. B. Lippincott Co. 1905. Pp. xii + 551. Copiously illustrated.

Pathological anatomy as a control of clinical observation has formed, and to a large extent still forms, the main basis of our more exact knowledge of disease. After the study of human anatomy had revealed to them the parts into which the body is divided, it was a very natural curiosity which prompted medical men to examine after death the bodies of human beings who during life had manifested phenomena which deviated from the normal. Indeed, before the era of modern experimental inquiry developed in medicine, facts of normal and pathological physiology had for the most part to be reached through the combined results of clinical and post-mortem observation. The discovery of the seat of disease, it was believed, would be most helpful in leading to a knowledge of its cause; this idea was shared by Morgagni, the distinguished founder of the science of pathological anatomy, as is evidenced by the title of his chief treatise: *De sedibus et causis morborum per anatomen indagatis,* and it was believed in by the great pathological anatomists, like John Hunter, who followed him.

At first, post-mortem pathology confined itself largely to the determination of variations in the gross form, consistence, appearance and weight of the more conspicuous organs, but gradually this naked-eye study became extended in a methodical way to all parts of the cadaver until to-day the macroscopic side alone of a completely performed autopsy has assumed formidable proportions. The microscopic study of pathological anatomy received a great impetus in the first half of the last century through the activities of the so-called pathological-anatomical school in France, the representatives of which, including Cruveilhier, Chomel, Andral and Louis, maintained that one of the chief functions of the physician consists of a search for pathological-anatomical alterations and of the investigation of the local products of disease; this view exerted an extraordinary influence in transforming the methods and theories of medical men. The tendency was transplanted by the celebrated Rokitansky to Vienna, where it was further developed. It reached its acme, however, in the work of Virchow, who, passing from macroscopic studies to microscopic examinations and taking advantage of the histological discoveries which were being made,

founded the so-called 'cellular pathology,' which refers all vital process, including the phenomena of disease, and all alterations of the organs and tissues, to the activity of the cells of which the body is composed. Microscopic pathological anatomy has been enormously in vogue since the middle of the last century, and histological technique has gradually attained to a manifoldness and complexity which is nothing less than appalling.

Still another phase of post-mortem pathology appeared when the relation of certain micro-organisms to the infectious diseases began to be established. Following upon the discoveries of Pasteur and Koch, the methods of bacteriology were applied at autopsies and our knowledge of disease has, as every one knows, been notably forwarded through such application. American pathologists especially have insisted upon systematic routine bacteriological examinations at autopsies.

Finally, the chemical study of the organs and tissues at post-mortem examinations remains to be developed. Only the crudest of beginnings has been made thus far in this direction; the whole field is as yet practically unexploited. That the time is about ripe for its cultivation seems obvious to many; a German scientist, writing to a friend in this country the other day, made the prophecy: 'Der zweite Virchow wird ein pathologische Chemiker sein.'

Coincident with the expansion of the subject, the technique of post-mortem pathology grew in extent and complexity. Two or three main types of books have been published as guides thereto—small works like those of Virchow, Chiari and Nauwerck, large books like Orth's 'Pathologisch-anatomische Diagnostik,' and others of intermediate size such as Mallory and Wright's 'Pathological Technique.' The volume before us, by Dr. Cattell, is of about the same size as Orth's book, but the plan followed is somewhat different and the subjects dealt with are more numerous.

After certain introductory chapters on the general features of post-mortems, the order of examination, the keeping of records, the use of instruments, and the care of the hands, the author takes up the examination of the external surface of the body. Then follows the opening of the great cavities and the study of their contained organs, the examination of the nervous system, of the sense organs, and of the bones and joints. Intercalated between the description of methods of examination, the diseases which may be met with in the individual organs are described and the corresponding pathological changes referred to. The first seventeen chapters of the book are devoted to the above-mentioned portions of the subject. The accounts given, though brief, are clear, and on the whole commendable. Occasional slips are made, some of them, perhaps, due to compression, as, for example, the classification of osteitis deformans under acromegaly.

The post-mortem examination of the newborn is dealt with in chapter XVIII.; in chapter XIX. the making of restricted post-mortem examinations is discussed, and in chapter XX. the student is told how to restore and preserve the body. The mode of preparation of the tissues for macroscopic and microscopic purposes occupies a special chapter, as does the topic of bacteriological investigation. Comparative post-mortems receive especial attention; one whole chapter is devoted to medico-legal suggestions, and another to an account of the Prussian regulations for the performance of autopsies in medico-legal cases. Toward the end of the book the usual causes of death are classified, and their nomenclature, complications and synonyms successively taken up. The volume closes with twenty-four pages in italics of references to the literature of the subject.

It will be seen from the above statement that many phases of post-mortem pathology rarely dealt with extensively in text-books have been carefully considered by Dr. Cattell. The number of methods given for any particular procedure varies; in some instances only the method of examining an organ preferred by the author is described; in other cases, a whole series of different methods is outlined, *e. g.*, for the examination of the brain, where Virchow's, Meynert's (modified), Pitres', Dejerine's, Hamilton's and Giacomini's methods, are all separately described. The

different chapters are copiously illustrated, largely by means of half-tone reproductions or photographs of stages of actual autopsies. Indeed, the book is much more fully illustrated on the side of macroscopic technique than are most manuals; there are only a few pictures, however, representing anatomical lesions. The index is full and well-arranged.

The fact that a second edition has been called for within two years of initial publication indicates that the book has met a distinct need in the country. Several improvements over the first edition have been introduced, including the chapter on the bones and joints, and nearly thirty new illustrations. Important changes have also been made in various chapters during the revision. The parts of the book dealing with the more modern and refined methods for microscopic examination of the tissues might with advantage be expanded in another edition; room for this could be obtained, perhaps, by omission of some of the chapters on pathology proper, as the latter will be thought by some to be too long for a book on autopsy-making and yet they are not full enough to serve as a textbook of pathology. There are but few things connected with autopsies that will not be found mentioned in the volume. Some professors of pathology may be inclined to use smaller manuals in connection with their practical teaching, urging that more than Dr. Cattell thinks desirable should be left to the intelligence of the student; instructors who desire a full account of all the technical processes, helped out by a large number of good illustrations, will find what they want in this book.

The publishers, too, have done their work well. The volume is satisfactorily made and is attractive in appearance. It deserves, and will undoubtedly acquire, a wide distribution among American medical students.

LEWELLYS F. BARKER.

Orchidaceæ: Illustrations and Studies of the Family Orchidaceæ, issuing from the Ames Botanical Laboratory, North Easton, Massachusetts. Fascicle I., by OAKES AMES, A.M. Boston and New York, Houghton, Mifflin & Co., The Riverside Press, Cambridge. 1905. Pp. viii + 156. Royal octavo.

From the preface we learn that the purpose of this work 'is to illustrate from type material, when possible, new or recently described orchid species, and species heretofore inadequately figured; to publish the original descriptions of all species so figured, with additional characterizations, full synonymy and geographical distribution; to furnish descriptions and descriptive lists of orchidaceous plants, which may prove useful in the study of regional floras; and to communicate the results of critical investigations among special genera.' This is certainly an ambitious undertaking, reminding us of a number of similar botanical projects undertaken during the last half-century, such as Gray's 'Genera' (1848–9); Gray's 'Forest Trees of North America' (begun in 1849, but never completed; published as a mere fragment in 1891, after the author's death); Goodale's 'Wild Flowers of America' (1879); Eaton's 'Ferns of North America' (1879–80); Sargent's 'Silva' (1891–1902) and Sargent's 'Trees and Shrubs' (1902–5). It is reassuring to know that the present undertaking is not dependent upon popular support, and that it is certain to have a reasonable permanence.

This fascicle includes descriptions and plates of five new and fourteen old species, a descriptive list of orchids collected in the Philippine Islands by United States Government botanists, a description and figure of a hitherto unrecorded orchid in the United States, and a paper entitled 'Contributions toward a Monograph of the American Species of Spiranthes.' We note with pleasure that all new descriptions are in Latin, as recommended several years ago by Professor Robinson as a corrective for the shocking illiteracy of some systematists. Following the Latin descriptions are somewhat more voluminous descriptions in English, followed by general notes, also in English. The plates are beautifully drawn, and illustrate the anatomical details with great clearness and fidelity.

The author shows a commendable conservatism in regard to specific distinctions, as is shown by the fact that he describes only five

new species, all from the Philippine Islands, and also by his treatment of *Spiranthes*, in which he distinguishes thirteen species for all of North America north of Mexico. That this promises a reduction in the number of catalogued species in North America is suggested by the fact that in the last edition of Gray's 'Manual' (covering only the northern United States east of the 100th meridian) there are six species; in Britton's 'Manual' (covering but little more territory) eight; and in Small's 'Flora of the Southeastern United States,' sixteen.

In regard to nomenclature the author says, 'the first specific name of each species under the correct generic interpretation, wherever this could be determined with reasonable surety, or employed without leading to complications, has been revived.' While this is probably too lax an application of the law of priority, the carefulness of the author in verifying every citation and in studying herbarium material will enable every orchid student to make any corrections that might be necessary under a stricter construction. Taken all in all this work is one which must be very highly commended, and which all botanists who are interested in orchids must look upon as a welcome addition to botanical literature.

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for April has but two articles, an annotated list of 'Birds of the Isle of Pines,' by Outram Bangs and W. R. Zappey, and 'Studies on the Plant Cell—V.,' by Bradley Moore Davis, dealing with cell unions and nuclear fissions in plants.

The Zoological Bulletin for April tells of 'Further Improvements at the Aquarium' and of 'Photography at the Aquarium,' this being illustrated by many reproductions of photographs of fishes, that of the large spotted moray being particularly good.

The Museums Journal of Great Britain has articles on 'The Relationship existing between Statue and Pedestal in Classical and Renaissance Times,' 'Educational Museums as Schools' and 'The Management of National Museums.' In the 'General Notes' is noticed the gift to the British Museum of a collection of 10,000 specimens of eggs of Palæarctic birds, and to the United States of the collections of etchings and paintings by Whistler, presented by Charles L. Freer, of Detroit. As the United States is the only great nation without a picture gallery it will be interesting to see what disposition will be made of this collection. The sale of a mounted specimen of great auk to an American museum is recorded, the price being £450, or about $2,200. This is the highest price ever paid for a specimen of the great auk.

The Popular Science Monthly for May contains:

E. RUTHERFORD: 'Present Problems of Radioactivity.'

FRANK WALDO: 'The Harvard Medical School.'

A. D. MEAD: 'Alpheus Spring Packard.'

WM. E. RITTER: 'The Organization of Scientific Research.'

T. H. MORGAN: 'The Origin of Species through Selection contrasted with their Origin through the Appearance of Definite Varieties.'

EDWARD S. HOLDEN: 'Galileo,' continued from the February number.

CHARLES E. BESSEY: 'Life in a Seaside Summer School.'

The Museum News for April contains a number of short articles referring to exhibits recently added to the collections of the Museums of the Brooklyn Institute.

SOCIETIES AND ACADEMIES.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

THE 401st regular meeting of the Biological Society of Washington was held April 8, 1905, with President Knowlton in the chair and 43 persons present.

The first paper of the evening was by Professor W. P. Hay, on 'A Class of Arthropoda New to the District of Columbia.'

The paper began with a brief description of a new species of *Macrobiotus*, a genus of *Tardigrada*, discovered in December, 1904, in an aquarium at Howard University. Attention was called to the fact that this is the first

record for the genus and class for the District of Columbia and the third for North America. This was followed by remarks on the structure of the tardigrades, their distribution and classification.

Although these animals have been shifted about from place to place until they now are regarded by most as Arthropoda, rather more closely related to the Arachnida than any other group, it was pointed out that such a disposition of them is incorrect. Except in number of appendages they show no resemblance to the Arachnida, nor can they be approximated to any other arthropodan group unless it be the Onychophora. Their relationship with the latter, even, is very distant, and in spite of the small number of species the Tardigrada should stand by themselves as a distinct class. It even may be necessary to place them alone in a distinct phylum as the supposed presence of segmented appendages in the genus *Lydella*, and the general possession of what are regarded as Malpighian glands only entitles them to a position among the Arthropoda.

In the second paper Mr. Wilfred H. Osgood discussed the characters and relationships of an 'Extinct Ruminant related to the Musk-Ox.' A specimen of a nearly perfect skull found in the Klondike gravels near Dawson, Yukon Territory, appears to represent an animal somewhat similar to the recent musk-ox (*Ovibos*) but generically distinct from it. It is evidently congeneric with *Ovibos cavifrons* of Leidy. The specimen, however, is much more complete than the remains studied by Leidy and presents many characters hitherto unsuspected. The animal was apparently larger than *Ovibos;* the general contour of the head was very different; and the horns, though directed downward, were more slender at the base and more divergent at the tips. The teeth were very large, even larger than those of the American bison (*Bison bison*), and were in fact more similar to those of the bison than to those of the musk-ox or the sheep. None of the characters suggest any connection with the sheep, but some of them might be taken to indicate relation to the bison, oxen, etc. There are, however, reasons for supposing that the present musk-ox has descended from an ancestor farther removed than either the oxen or the sheep.

That the extinct form bears an ancestral relation to the recent musk-ox, there can be little doubt. Interesting in this connection is the fact that some of the characters in the adult fossil form are found in the recent form only before it has reached maturity.

The third paper was by Dr. Barton W. Evermann, on the 'Trout of the Kern River Region.' This paper was illustrated by water-colors, proofs (in color) and lantern slides. Dr. Evermann said:

The Kern River flows nearly due south through a deep canyon with abrupt walls several hundred feet high. The tributary streams from the east as well as from the west flow across the high mountain plateau in a relatively gentle course, then drop in one or more considerable falls from the high plateau to the floor of the Kern canyon. These falls are at present usually so great as to form impassable barriers to the ascent of fish, and as a result many of the streams are wholly without fish of any kind. But in others, as Volcano Creek, Soda Creek, Coyote Creek and others, trout found their way and subsequently the falls became greater and the trout became isolated. In this way, although originally peopled from Kern River, each of many of these smaller streams came to have in it a colony of trout wholly segregated from all other trout and in time the trout of each of these streams became differentiated and now can be readily distinguished from those of other streams. Among those which are best differentiated are those of Volcano Creek, South Fork of Kern and Soda Creek. These must be regarded as three distinct species, only one of which has as yet been named.

E. L. Morris,
Recording Secretary.

THE CLEMSON COLLEGE SCIENCE CLUB.

The fifty-second regular meeting was held on February 17, at 8 P.M. Professor T. G. Poats presented a paper on 'Radium and Radioactive Substances' which was extensively illustrated by lantern slides, exhibition

of the minerals which are the sources of radioactive substances, and by the spinthariscope.

The research paper by Professor C. E. Chambliss, 'Notes on the Rhinoceros Beetle,' was read by title.

The fifty-third regular meeting was held on March 24, at 8 P.M. Professor S. W. Reaves presented a paper on 'The Problem of the Duplication of the Cube.' Dr. F. H. H. Calhoun gave a report upon 'The Origin of the Mont Pelée Mud Flow.' A careful examination of the dust comprising this flow showed that it had been formed by the grinding of crystal-bearing rocks at temperatures below the melting point. Volcanic dust usually consists of small isotropic glass particles with or without a small per cent. of crystalline material. The particles in the flow from Mont Pelée were crystalline, broken, and some of the quartz crystals showed the wavy extinction due to strain. This of course may have been developed in the original rock mass instead of at the time of the formation of the dust itself. The following minerals were recognized in the dust: quartz, feldspar, hornblende, mica, an opaque iron mineral, and a pyroxene. The crystals were so shattered and strained that accurate determination was impossible.

Informal communications were presented on 'the tantalum lamp,' 'life and work of Professor A. S. Packard,' and 'the engineering problems involved in the raising of the Maine' by Professors W. M. Riggs, Haven Metcalf and P. T. Brodie, respectively.

Haven Metcalf,
Secretary.

DISCUSSION AND CORRESPONDENCE.

SUGGESTIONS TOWARD A PHYTO-GEOGRAPHIC NOMENCLATURE.

The terms formation and association are, perhaps, now used by most plant ecologists and geographers with something like scientific exactness. The word *formation* suggests the idea of an area of vegetation of a character marked enough to be essentially different from contiguous areas, the prominent forms of vegetation in this area having the same general aspect and adaptations corresponding with distinct physiographic positions. Such formations do not show an even mixture of plants, because such plants are collected into definite groups, or societies dependent somewhat upon the general conditions of the environment, but more especially because of the influence of historic or edaphic factors. Such assemblages of plants are called properly *associations.* The members of the association are looked upon as *vegetation forms.* The term *facies* is also a phytogeograpic concept, happily used with scientific accuracy. But the term *zone* is used somewhat loosely for very different ideas. The word is used in a latitudinal or climatic sense, and we speak of temperate and tropic zones. It is used for the areas at different elevations on the mountain side, hillside or bluff face. Again it is used to denote the arrangement of marine algæ on the sea coast, or for the concentric growth of aquatic plants about the lagoon of a pond or lake.

Humboldt (1805) applied the word zone to the vegetation, the distribution of which was determined by latitude. Schouw (1823) followed Humboldt and Bonpland in the use of the word in the latitudinal sense, and Kabsch (1855) also. It seems then that the word should be used in the restricted sense of a particular portion of the earth's surface determined by referring its position to the parallels of latitude. The concept of bands of vegetation on the mountain side, hillside or bluff face with respect to the altitudinal distribution of plants is best preserved by the use of the word *belt,* and we would speak of forest belt, subalpine belt, alpine belt, and where necessary this application could be extended to zonation on a bluff face. This usage is suggested, notwithstanding the importance of emphasizing the identity of zonation due to climate and that due to altitude, because for practical reasons the two ideas must be kept distinct. The writer wishes to suggest for the concentric bands of vegetation at times so clearly marked in lakes or pond, the term *circumarea,* for in mathematics, circumarea is the area of a circumscribed circle. We might then speak of a water-lily circumarea, a cat-tail circumarea, a shrubby

circumarea. To express the submerged zonation on the sea coast, the English word *shelf* can be used. This is authorized by everyday speech, for we refer to a shelf of rock, a continental shelf, or a shelving beach. To speak of the marine shelves, *i. e.*, the *Fucus* shelf, the *Laminaria* shelf, would be to use the word with exactness. For the zonation of a beach, strand, river shore or prairie edge, the writer suggests the word *strip*. We should then speak of the shrubby strip, the grassy strip, the forest strip, etc. The idea of zonation on a river island, where the vegetation of a particular band runs completely around the island, and not continued lengthwise, as the word strip implies, the term *girdle* could be used. For forest zonation, where it is vertical, the term *layer* (stratum), or story ought to be accepted.

These terms are proposed because it seems to the writer that as the time approaches for the convocation of the Botanical Congress at Vienna in June, a full ventilation of nomenclatorial views should be made, not only for discussion, but also as suggestions to those who will take part in the deliberations of the congress.

John W. Harshberger.
University of Pennsylvania.

SPECIAL ARTICLES.

ON THE HABITS OF THE GREAT WHALE SHARK (RHINEODON TYPUS).

One of the most interesting of fishes and by far the largest of all is the *Rhineodon typus* (better known by the later name *Rhinodon typicus*). This has received the quasi-vernacular name whale shark, although, under the native Indian name (Mhor) it has been the object of a regular fishery for a long time along the northwestern coast of India (Sind). One might naturally suppose that the animal was so rare that nothing was known of its range or habits if the most recent works, popular as well as scientific, were consulted, but really, scattered through various volumes, many data may be found. A gentleman desirous of learning the history of the fish was unable to find data I informed him about, even after I had told him in what periodicals they were published. I, therefore, found them for him, and the difficulty that had been experienced by him, and may be by others, leads me to summarize the information that may be gleaned.

The species was first named *Rhineodon** *typus* by Dr. Andrew Smith in 1829, in the *Zoological Journal*, and the genus was adopted by Bonaparte in 1832 in the *Giornale arcadico di Scienze*, etc. (vol. 52). The numerous subsequent modifications of the name and notices of the species do not demand consideration in this place.

In 1850 an article, 'On Shark Fishing at Kurrachee' was communicated by George Buist to the *Proceedings of the Zoological Society* (pp. 100–102) and in it is an unmistakable reference to the whale shark, but which has been overlooked and not identified by Indian or other zoologists. From this and other recent sources the following account is compiled.

* * * * * * * *

The greatest—the most gigantic—of the sharks is one not uncommon in the Indian Ocean, but which, on account of its huge size, is represented by remains in very few museums and is little known. It is the *Rhineodon typus*, the type not only of the genus *Rhineodon*, but of an independent family—Rhineodontids; the not inappropriate name whale shark has been coined for it.

The whale shark is a huge animal occasionally, it is said, attaining to a length of sixty feet, although the average size is much less; it may be considered a pelagic species, not willingly often approaching land. It is a slow, apathetic animal, mostly living near the surface of the ocean and often resting, idly floating along and supposed to be 'sleeping.'

Its gigantic size is in inverse ratio to its food. Unlike the giant *Carcharodon* or man-eater, it has extremely small teeth and its food consists of very minute animals. Its teeth, indeed, are quite similar (in a general way)

* The generic name was misprinted *Rhincodon*—evidently a typographical error.

to those of a skate (*Raia*), almost immovable, in many transverse rows, and with acute backward-directed points and bulging heel-like bases. It has a straining apparatus, somewhat like that of the basking shark (*Cetorhinus maximus*) and its food is analogous to that of its northern relative. It consists of the minute copepod and other crustaceans as well as mollusks which live about the surface of the ocean. These flourish in such abundance as to compensate by their number for their small size. In fact, like those other giants of the sea, some of the whale-bone whales, it finds enough for growth and the enjoyment of life among the smallest of animals.

Nothing is known of its reproductive habits but it has been assumed that, like its nearest relatives, it is ovoviviparous.

According to E. Perceval Wright, 'it is quite a harmless fish, with a mouth of immense width, furnished with small teeth,' really very minute. "It now and then rubs itself against a large pirogue, as a consequence upsetting it, but under these circumstances, it never attacks or molests the men, and while it reigns as a monster among the sharks, is not, despite its size, as formidable as the common dog-fish"—save in the line of upsetting!

Dr. Buist, as early as 1850, referred to it as the 'mhor or great basking shark' and stated that it was frequently captured at Kurrachee (not far from the mouth of the Indus). "It is found floating or asleep near the surface of the water; it is then struck with a harpoon." The stricken fish is "allowed to run till tired; it is then pulled in, and beaten with clubs till stunned. A large hook is now hooked into its eyes or nostrils, or wherever it can be got most easily attached, and by this the shark is towed on shore; several boats are requisite for towing. The mhor is often forty, sometimes sixty, feet in length; the mouth is occasionally four feet wide."

The later literature respecting the species has been already summarized in SCIENCE (1902, N. S., XV., 824–826).

THEO. GILL.

A FAUNAL SURVEY OF THE FOREST RESERVES IN THE SANDHILL REGION OF NEBRASKA AND OF THE LAKES IN THAT REGION.

NEBRASKA is, from a faunal standpoint, one of the most interesting states in the Union. Owing to its geographical location, to a range in altitude of from 810 to 5,300 feet, to variations in soil, climate and vegetation, the state contains a fauna rich in species and in great variety. Along the Missouri River, which forms the eastern boundary of the state, and following westward out the tributary streams into the prairie region, is a growth of purely deciduous timber representing species of trees derived from the south and east and including oaks, hickories, walnut, butternut, honey locust, Kentucky coffee-tree, wild cherry, etc.; while spreading into the state from the north and west and following down the Niobrara River nearly to its mouth is a growth of pine, together with quaking aspen, balsam poplar, mountain maple and black birch.

Midway across the state and at an average altitude of 3,000 feet lies a region of extreme interest, one of sandhills, varying in height up to 250 feet, so thickly scattered as to make a surface as rough as can well be imagined. The region is sharply defined. Streams flow out of it toward the east and south which have carried away sand to deposit it as sandbars lower down their courses, making in that way valleys running back into the hills and up which extend fringes of low trees and shrubbery, the advance guard of the tree growth from the southeast. To the north and west of this region are plains cut into by pine-clad canyons. In the sandhill region proper, however, no native trees of any kind are found, although there are here and there patches of stunted bushes—sand cherry, plum, rose, *Ceanothus* and June berry. Throughout this area, which in extent equals one fifth the total area of the state, or about 11,000 square miles, forest conditions are quite absent and forest animals absolutely lacking.

In this region the government has recently set aside two tracts of land as forest reserves. One, known as the Dismal River Reserve, in Thomas County, has an area of 86,000 acres, the other, the Niobrara Reserve, in northern

Cherry County, an area of about 126,000 acres. It is the intention to plant pines upon the hills and deciduous trees in the valleys, hoping thus to prove the possibility of foresting the sandhills and to induce private parties following its lead to aid the government in the work of reclaiming this region. The writer believes that here is a unique opportunity to study the development of a forest fauna from the beginning. These planted forests are by far greater in area than any forests ever planted before, and in them will be seen the gradual evolution of forest conditions, and, it may be assumed, the gradual development of a forest fauna, where absolutely no trace of such a fauna is to be found at the present time. The question suggests itself at once as to the possible origin of this fauna. Will it be derived from the pine-clad canyons of the north and west or will it come from the deciduous timber of the south and east? Will the pine growth receive its fauna from one direction and the deciduous forest in the valleys its from the other? If so, what will be the ultimate result? What will be the order of appearance of these forms and what will be the possible succession of dominant types which may exist one after the other in the evolution of this fauna from year to year? These are only a part of the problems that present themselves, the working out of which will be the labor of many years. During the past three years the author has been studying all of the conditions as they now exist in order to thoroughly familiarize himself with the ground, that the investigation may be followed through intelligently from the very beginning. How soon results may be attained and how important they will be the future must disclose.

Bound up in the study of the sandhill region and its fauna, though not directly connected with the investigation above outlined, is another problem which the author is also studying at the same time. In this region are many bodies of water differing in size, from mere pools to lakes even four or five miles in length, most of them fed from subterranean streams and with no outlet, lying in pockets between the hills. These vary from those containing the most beautifully clear, limpid, sweet water, full of animal and vegetable life, to those so strongly alkaline as to be incapable of supporting more than a limited fauna and flora and that made up of a very few species. The study of the distribution of life in lakes so widely different in chemical composition of the water, but in every other respect absolutely similar, promises extremely interesting results, not the least important of which will be the possible variation of the same species under these varying degrees of alkalinity.

It is three years since these investigations were begun. The first of these years was spent in a general survey of the region and in mapping the largest group of lakes, the second and third in a more critical study of lake conditions, the collecting of material, and the securing of a series of photographs. The work is to be continued during the present summer by the taking of water samples from as many lakes as possible for chemical analysis, by further study of the conditions in the lakes themselves and of the biological conditions in the region as a whole, and in the securing of additional photographs to illustrate them. The investigation is being carried on very largely at private expense, since there is no fund available in the state for the purpose; but the intention is to spend as much time as possible each year in the field, results being published from time to time as they may become complete so far as any given problem is concerned, or whenever the progress of investigation makes it possible to present definite results.

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THE MAILED CATFISHES OF SOUTH AMERICA.

In the *Transactions* of the Zoological Society of London, Volume XVII., Part III., October, 1904, C. Tate Regan publishes a 'Monograph of the Fishes of the Family Loricariidæ.' The Loricariidæ are one of the families of Ostariophysi. They are found only in the rivers of South America, ranging from Panama to Montevideo. As understood by Regan the Loricariidæ are equivalent to the Loricariidæ and Argiidæ of Eigenmann.

They are characterized by their reduced maxillary, the absent symplectic and suboperculum, the union of supraoccipital and parietals to form a single parieto-occipital bone, the absence of parapophyses, the sessile ribs and the compressed caudal vertebræ. All but the Argiinæ are covered, in part at least, by bony plates.

Mr. Regan's paper is based on the material in the British Museum and the Paris Museums and the types in the Harvard collections. A total of 189 species are recognized, thirty-four of which are described as new.

The genera and sometimes the species are found widely distributed; two of the genera, *Chætostomus* and *Arges*, are confined to the Andes of Peru. A table gives the known geographical distribution of all the species. In this table the following systems are considered as units: (1) Western coast-streams of Peru and Ecuador; (2) Rio Magdalena system (with Panama); (3) Venezuela and Guiana; (4) Upper Amazon (the Amazon and its tributaries above its junction with the Yapura); (5) middle and lower Amazon; (6) Rio Paranahyba and Rio San Francisco and their tributaries, and smaller coast streams in their neighborhood; (7) Rio Parahyba, Rio Grande do Sul and other coast streams of southeastern Brazil; (8) Rio de La Plata and its tributaries.

Little need be said of this classification except that it has long been known that Rio Grande do Sul should be classed with the Rio de La Plata and that the coast streams from Rio de Janeiro to Bahia form a natural unit distinct from the rivers to the north or south. About fifty genera that are found both in the Amazon on the north and the La Plata on the south are absent from this area. The Rio Paranahyba should probably be classed with the Lower Amazon. The Pacific slope of Panama should be classed with western Peru and Ecuador. The number of species in these systems is, respectively, 15, 18, 35, 64, 42, 17, 29, 32. Approximately one third of all the species are found in the upper Amazon, while but half as many are found in the vast La Plata Basin.

Brief chapters on sexual differences and changes during growth introduce the systematic portion of the paper. The systematic paper makes a distinct advance over the last revision of this family by Eigenmann and Eigenmann* in so far as Regan takes into consideration the details of the skeleton of the various groups, and inasmuch as he had a much more abundant material, especially of the species grouped by Eigenmann under the generic names *Hemiancistrus* and *Chætostomus*.

Considerable difference exists between the two papers on account of the estimate placed on the importance of some characters. Regan accepts fewer genera.

For museum purposes and for purposes of general classification larger genera and fewer names are preferable, but for all more intimate discussions of variation, geographical distribution and genetic origin of faunas smaller units are vastly preferable. Regan's species are also museum species with little recognition of the biological significance of varieties. For instance, Eigenmann and Eigenmann accepted the *Plecostomus affinis* of Steindachner as a variety of *commersoni* (not of Val.) = *punctatus*. The parent, or type form, is from Rio Janeiro, Santa Cruz, Macacos, Itabapuana, Rio Parahyba, the variety *affinis* from Rio Janeiro, Mendez, the rios Mucuri, Parahyba, Muriahe, Doce and San Antonio. The variety *affinis* is more abundant than *punctatus*, 'over 50 specimens having been examined ranging from .13–.26 m.' A second variety was described, three specimens .30–.35 m., from São Matheos. Of these varieties Regan says:

> These varieties [based in one case on over fifty specimens] scarcely seem worth recognition; in all young specimens the spots are large and the lower surface of the head and abdomen partially naked, and the persistence of these features in the adult must be regarded as cases of individual variation only.

Of *Plecostomus lima atropinnis* Regan says: Eigenmann has given the name *P. lima atropinnis* to a specimen (presumably of this species) from Goyaz, with the fins uniformly

* 'A Revision of the South American Nematognathi,' Occasional papers, Cal. Acad. Sci., I., pp. 1–508, 1890.

dark brown." Regan considers this variety distinct from *lima* and names it *garmani*. Of course, if the variety *atropinnis* is distinct from the parent form it must go by the older name *atropinnis* and not *garmani*.

Eigenmann's genus, *Loricaria*, is divided as follows:

I. Teeth in the jaws in small or moderate number, not setiform; a more or less distinct orbital notch.

a. Snout rounded or pointed, not or not much, produced .... *Loricaria*.

aa. Snout produced with a long rostrum, *Hemiodontichthys*.

II. Teeth in the jaws numerous, setiform; orbit circular, without distinct notch.

b. Dorsal opposite to the ventrals. *Oxyloricaria*.

Admitting that group I. is distinct from group II. there is no reason why the second group should not also be divided as group I. is, and, indeed, Regan does divide it as follows, but does not use generic or subgeneric names to designate the divisions:

b. Snout rounded or pointed, not produced as a rostrum.

bb. Snout produced, forming a distinct rostrum; sides of the head in the male, margined with bristles.

The group under *b* contains the type of Steindachner's genus *Harttia;* the second is the *Sturisoma* of Swainson.

The *Hemiodontichthys* of Regan contains two distinct generic types, the one with the snout expanded at the tip (the *Hemiodontichthys* of Bleeker), and the other with the snout simply pointed (the *Hemiodon* of Bleeker). *Hemiodon* being preoccupied, this genus may be termed *Reganella,* in recognition of this author's invaluable services in reviewing the group.

Arranging the respective genera or subgenera as far as possible opposite each other, a comparison of the results of Eigenmann in 1890 and of Regan in 1904 gives us the following.

Families and Subfamilies. Genera. Subgenera.	No. of Species.	Families and Subfamilies. Genera. Subgenera.	No. of Species.
Argiidæ.		Argiinæ.	
Arges,	4	*Arges,*	19
Cyclopium,	2		
Astroblepus,	1	*Astroblepus,*	1
Loricariidæ.		Loricariidæ.	
Loricariinæ.		Loricariinæ.	
Farlowella,	6	*Farlowella,*	7
Hemiodontichthys,	1	*Hemiodontichthys,*	2
Loricaria,	30	*Loricaria,*	40
Hartia,	1	*Oxyloricaria*	10
Oxyropsis,	1		
Hypoptopominæ.		Hypoptopomatinæ.	
Hypoptopoma,	3	*Hypoptopoma,*	6
Hisonotus,	1		
Parotocinclus,	1		
Otocinclus,	2	*Otocinclus,*	9
Plecostominæ.			
Microlepidogaster,	1		
		Neoplecostominæ.	
Neoplecostomus,	2	*Neoplecostomus,*	1
		Plecostominæ.	
Plecostomus,	24	*Plecostomus*	26
		(*Plecostomus* 21)	
Rhinelepis,	4	(*Pogonopoma* 3)	
		(*Rhinelepis* 2)	
Cochliodon,	1	*Panaque,*	4
Panaque,	8		
		Pseudacanthicus	
		Ancistrus,	31
Hemiancistrus,	18	(*Lasiancistrus* 4)	
Pterygoplichthys,	8	(*Ancistrus* 18)	
Parancistrus,	3	(*Parancistrus* 3)	
Pseudancistrus,	5	(*Pseudancistrus* 6)	
Delturus,	2		
Hemipsilichthys,	1	*Hemipsilichthys,*	1
Acanthicus,	2	*Acanthicus,*	1
Chætostomus,	20	*Chætostomus,*	15
Ancistrus,	8	*Xenocara,*	12
Total,	155		189

Unfortunately there is nowhere in the paper any indication what species were used as the types of old or of new genera to help future reviewers and similarly there is nowhere with the synonymy and bibliography any indication of the locality from which species were recorded to help future students of geographical distribution.

The rules of nomenclature adopted differ in principle from American usage. The first species, the well-known *Plecostomus plecostomus* Linnæus, appears by the later name, *P. guacari* Lacépède. *Cochliodon* Kner is rejected apparently on account of the use of *Cochlodon* D'Orbigny, while *Trichomycterus* is used, although it is a misspelling merely of *Thrichomycterus,* which is another genus. *Cyclopium* Swainson is rejected because 'his generic name, being derived from the genitive plural of *Cyclops,* is as inadmissible as would be that of *Silurorum.*' *Oxyloricaria* is used because the older *Sturisoma* is a 'nomen hybridum.' The writer would be very glad to be able to take back and make over the inelegant, barbarous or otherwise objectionable names he has inflicted upon respectable fishes, but, with his American confreres, he abides by the rule, both for himself and for others, that a name is a name no matter by whom conferred or however wonderfully made. How

dangerous it is to deviate from this rule is made evident by the fact that no less a classical scholar than Regan himself has mistaken the neuter adjective *Cyclopium* for the genitive plural of *Cyclops*. If, as Regan thinks, *Cyclopium* is not generically distinguishable from *Arges*, all the species should go by the older name *Cyclopium*.

The reason for shifting the name *Ancistrus* from *cirrhosus* as the type are not apparent and should have been distinctly stated. The name *Ancistrus* was proposed by Kner (Hypostomiden 272, 1853) for the following described species and one of them must be considered the type:

(*a*) Brachypteri: (1) *cirrhosus*, (2) *dolichopteri*, (3) *gymnorhynchus*, (4) *mystacinus*, (5) *pictus*, (6) *brachyurus*, (7) *scaphirhynchus*. To these described species Kner adds *medians* and *itacua*. Of *mystacinus* he says: "Diese Art scheint dem *Hyp. guacharote* Val. sehr nahe zu stehen, doch lässt sich bei der Ungenauigkeit der Beschreibung des letzten über die etwaige Gleichartigkeit beider nich sicher entscheiden."

(*b*) Macropteri: (1) *duodecimalis*, (2) *longimanus*, (3) *gibbiceps*, (4) *litturatus*.

It is to be emphasized that *guacharote* was known to him only from a description, considered too general for specific distinctions.

Gill ('Synopsis of the Freshwater Fishes of the Island of Trinidad,' 47) amended the genus *Ancistrus* by separating the species of group (*b*) under the new name *Pterygoplichthys*, saying: "The genus *Ancistrus* seems to have been framed with especial regard to those fishes to which the name is here restricted, and is by Dr. Kner divided into two sections, which correspond to *Ancistrus* and *Pterygoplichthys*, his section '*a*' answering to the former genus, and '*b*' to the latter." A more definite restriction to the species described by Kner could not be desired. The *Ancistrus* of Gill is identical with section '*a*' of the *Ancistrus* of Kner. Gill described some specimens from Trinidad as *Ancistrus guacharote* Val. This is the first formal introduction of *guacharote* to the genus *Ancistrus*. But Günther later maintained that the *guacharote* of Gill is not that of Valenciennes and named the former *trinitatis*. Regan has been unable to decide whether *trinitatis* is distinct from *guacharote* or not; nevertheless, it appears that on the fact that Gill described *guacharote* Regan has selected the latter as the type of the genus *Ancistrus*. Gill did not formally select *guacharote* as type, and if any inference is permitted it must certainly be that the first species described by Kner, *cirrhosus*, is the type—certainly not the *guacharote* or *trinitatis*, which was unknown to Kner. However, neither Kner nor Gill specifically indicated a type. Bleeker* formally selected *cirrhosus* as the type, and there seems to be no reason why *cirrhosus* should be placed anywhere than in the genus *Ancistrus*. Nevertheless, this species is placed in a new genus, *Xenocara*. *Guacharote*, on the other hand, is placed in the genus *Ancistrus*, and strange enough in a new subgenus, *Lasiancistrus*. There may be reasons for the ruling in these premises but they are not evident from a perusal of the paper. Regan's name *Xenocara* may be retained for those of the Ancistroids without tentacles.

Regan's monograph is so welcome a contribution and so enthusiastically conceived and executed that it is ungracious to differ with the author in the minor points indicated.

C. H. EIGENMANN.

* *Nederl. Tijdschr.*, I., 1863, 77.

CURRENT NOTES ON METEOROLOGY.

KITE-FLYING AT SEA: RECENT RESULTS.

THE results obtained by means of kite-flights from the Prince of Monaco's yacht during the summer of 1904 are discussed by Professor Hergesell in the *Comptes rendus*, Vol. CXL., p. 331. Twenty-five ascents were made, eight in the Mediterranean, one in the Baltic and sixteen in the Atlantic. In the region of the trades the adiabatic gradient, of 1° in 100 meters, is always found in the lowest strata, and is even exceeded, the thickness of this stratum being between 100 and 600 meters. The relative humidity rises from 70 per cent. or 80 per cent. at sea level to 95 per cent. or 100 per cent. Above this stratum the temperature rises quickly several degrees, and the humidity

diminishes suddenly to below 50 per cent. The temperature continues to rise through a stratum sometimes 1,000 meters in thickness, and the humidity decreases to 10 per cent. or 20 per cent. Above this stratum the adiabatic rate is again met with, but the humidity is low. The northeast trade, with a velocity of about sixteen miles an hour, prevails at sea level. At greater altitudes the wind shifted gradually through north to northwest, and in two instances through east to southeast and south. No southwest current (anti-trades) was shown by the kites. The northwest or southeast winds in the highest strata had a velocity not over seven or nine miles an hour. In the intermediate strata the velocity was generally even lower (*Nature,* March 16, 1905, 467; *Ciel et Terre,* March 16, 1905, pp. 47–49).

MOUNTAIN SICKNESS.

IN an account of 'Five Ascents to the Observatories of Mont Blanc' (*Appalachia,* Vol. X., No. 4), Mr. A. L. Rotch describes his different experiences, and pays special attention to the physiological effects of the high altitudes. On the first ascent, at a height of 14,320 feet, where the night was spent, the author suffered with this most distressing malady, but was afforded some relief by breathing oxygen. In the morning he was well enough to aid in setting up the barometers and to undertake preliminary spectroscopic observations. Another night, spent at the Vallot cabin, 1,460 feet below the summit, was also made unpleasant by a repetition of the discomforts of mountain sickness. On a second expedition oxygen failed to give any relief, but some alleviation was obtained by the use of phenacetine. The third ascent was marked by suffocation and dizziness during the night spent at the Grands Mulets shelter, the pulse rising to 100, the altitude being comparatively low. Mr. Rotch attributes these symptoms to a large quantity of quinine which he had taken before starting. On the further climb, great difficulty was experienced in walking, and there was hardly strength enough, at the Vallot Observatory, to gather up the sheets of the recording instruments. A fourth ascent was accomplished without difficulty, the author being 'in prime condition' on the summit.

MONTHLY WEATHER REVIEW.

THE November number of the *Monthly Weather Review* (dated January 31, 1905) contains the following articles of general scientific interest: 'Airy's Theory of the Rainbow,' by Rev. D. Hammer, S.J.; 'Radiation in the Solar System,' being an address delivered before the British Association by Professor J. H. Poynting; 'A Simple, Effective and Inexpensive Lightning Recorder,' by H. F. Alciatore; 'An Honest Long-range Forecaster,' 'Meteorological Course at Williams College,' 'Meteorology in New South Wales,' 'Deflection of Thunderstorms with the Tides,' 'A Proposed International Contest of Weather Forecasters.'

FLOODS IN THE SAHARA.

OCCASIONAL sudden downpours of rain, somewhat similar in character to our western cloudbursts, occur in the mountains of the Saharan region, causing floods, and even loss of life. On the evening of April 12, 1899, near Berrian, 300 miles south of the city of Algiers, a flood of this character swept down the usually dry bed of a wady, and caused the death, by drowning, of some French soldiers who were encamped in the bed. A recent case of the same kind is reported in the *Bulletin* of the *Comité de l'Afrique,* No. 11, 1904. On October 21 the village of Aïn Sefra, in southern Algeria, on the edge of the Sahara, was overwhelmed by floods which suddenly rushed down two wadys. The floods were due to very heavy rains which had fallen on a neighboring mountain range. Ten Europeans and fifteen natives were drowned. The flood is reported to have subsided about fifteen minutes after reaching the town.

THE GUINEA CURRENT.

IN 1895 there was published by the Meteorological Institute of the Netherlands a report entitled 'De Guinea en Equatoriaal Stroomen,' dealing with the currents, temperature, winds, specific gravity of ocean water, pressure, frequency of rainy days, etc., of the re-

gion between the equator and lat. 25° N., and between the meridian of Greenwich and long. 40° W. A new edition of these charts has now been issued ('Observations océanographiques et météorologiques dans la Région du Courant de Guinée,' 1855–1900. (1) Texte et Tableaux, pp. iv + 116, (2) Planches, VIII. Utrecht, 1904). R. DEC. WARD.

SCIENTIFIC NOTES AND NEWS.

SIR PATRICK MANSON has been invited to give the Lane lectures at the Cooper Medical College, California, this year. He will lecture on some aspect of tropical diseases.

PROFESSOR J. N. LANGLEY, of Cambridge, will give one of the general lectures at the meeting of the Association of German Scientific Men and Physicians, which opens at Meran on September 24. His subject will be 'Recent Researches on the Nervous System.'

LORD RAYLEIGH is about to retire from the professorship of natural philosophy at the Royal Institution, which he has held for eighteen years. He will be made honorary professor. Lord Rayleigh has given twenty-three Friday evening discourses and twenty-one courses of afternoon lectures at the institution.

LORD LISTER celebrated his seventy-eighth birthday on April 5.

PROFESSOR EUGENE W. HILGARD, of the department of agriculture of the University of California, has been granted leave of absence for next year. Professor Hilgard, who is seventy-two years of age and has held his chair in California for thirty-one years, is privileged to retire with two thirds salary, according to the statutes of the university.

A MARBLE portrait bust is to be installed at Brussels in honor of Dr. Beco, secretary-general of the Belgian Department of Public Health.

A GOLD medal in honor of Professor Pozzi, the eminent French surgeon, by the sculptor Chaplain, is to be presented to him by his colleagues and pupils.

THE students of Jefferson Medical College will at the approaching commencement present to Dr. Forbes a life-size portrait of himself. Dr. Forbes has taught anatomy in Philadelphia for forty-nine years.

THE health of Lord Kelvin is much improved and he was expecting to be able to leave London shortly for a change of air.

PROFESSOR H. E. GREGORY, who has been ill with inflammatory rheumatism, has much improved, and expects to resume his university duties in the course of several weeks.

SIR RICHARD DOUGLAS POWELL has been elected president of the Royal College of Physicians in succession to Sir William Church.

MR. JOHN GAVEY, C.B., engineer-in-chief to the Post Office, has been nominated for election as president of the British Institution of Electrical Engineers for 1905–6. Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory, and Mr. J. E. Kingsbury, of the Western Electric Company, have been nominated for the office of vice-president.

PROFESSOR THOMAS M. GARDNER has resigned his chair in the faculty of mechanical engineering at Cornell University.

MR. E. T. NEWTON, F.R.S., paleontologist to the British Geological Survey, retired on May 4, after forty years of service. He is succeeded by Dr. F. L. Kitchin.

WE learn from *Nature* that the Baly medal, given every alternate year on the recommendation of the president and council of the Royal College of Physicians of London for distinguished work in the science of physiology, especially during the two years immediately preceding the award, has been awarded to Professor Pavlov, of St. Petersburg. The Bisset Hawkins gold medal for 1905, given triennially for work deserving special recognition as advancing sanitary science or promoting public health, has been awarded to Sir Patrick Manson, K.C.M.G.

THE Jacksonian prize of the Royal College of Surgeons has been awarded to Mr. H. J. Patterson for his essay on 'The Diagnosis and Treatment of such Affections of the Stomach as are Amenable to Direct Surgical Interference.'

Dr. Nettie Maria Stevens, of San Jose, California, associate in experimental morphology at Bryn Mawr College, has been awarded the prize of $1,000 offered every two years by the Association for Maintaining the American Woman's Table at the Zoological Station at Naples and for Promoting Scientific Research by Women. This is the second award of the prize which is offered for the best thesis written by a woman on a scientific subject. Miss Stevens graduated from Stanford University in 1899, and received the degree of doctor of philosophy from Bryn Mawr College in 1903. During the past year she has held a Carnegie assistantship in addition to her position at Bryn Mawr. The thesis which won the prize is on 'The Germ Cells of the *Aphis rosea* and the *Aphis œnotheræ*.'

The Smithsonian Institution has made a grant of $250 from the Hodgkins Fund to Professor W. P. Bradley, of Wesleyan University, for an experimental study of the flow of air at high pressure through a nozzle. The subject of this investigation is of fundamental importance in connection with the usual method of liquefying air.

Dr. Raymond Pearl, instructor in zoology at the University of Michigan, has been granted leave of absence for a year. He will spend the year abroad, continuing his work on variation from the biometrical standpoint, having received a grant for this purpose from the Carnegie Institution.

Sir William Huggins, president of the Royal Society, made one of the speeches at the anniversary banquet of the Royal Academy of Arts, held on April 29.

Professor John Adams, head of the department of education of the University of London, is to deliver a course of lectures in the School of Education of the University of Chicago during the summer quarter.

Professor John Dewey, of Columbia University, lectured at Harvard University on May 5, his subject being 'Knowledge and Action.'

The following provisional program of public evening lectures at the Marine Biological Laboratory, Woods Hole, Mass., has been arranged; other lectures will be announced later:

June 30, Miss Adele M. Fielde, 'The Power of Recognition among Ants.'

July 5, Dr. A. J. Carlson, 'The Physiology of the Heart.'

July 7, Professor A. P. Mathews, 'The Chemical Basis of Life.'

July 12, Professor H. S. Jennings, 'The Behavior of Lower Organisms.'

July 14, Dr. R. M. Yerkes, 'The Behavior of Higher Organisms.'

July 19, Professor A. D. Mead, 'Some Observations on the Natural History of Marine Animals.'

July 21, Miss Katherine Foot and Miss E. C. Strobell, 'Maturation and Fertilization of the Egg of *Allolobophora fœtida*.'

July 26, Professor W. B. Scott, 'Miocene Ungulates of South America.'

A marble memorial of the late Professor Giulio Bizzozzero is to be placed in the Institute of General Pathology at Turin.

Dr. Joseph Everett Dutton died in the Congo on February 27 at the age of twenty-nine years. He was sent to Africa by the Liverpool School of Tropical Medicine to investigate trypanosomiasis and tick fever.

We regret also to learn of the death of Professor Otto Struve, director of the Poulkowa Observatory from 1862 to 1890, which took place on April 14, at the age of eighty-five years.

Plans have been filed for a fifteen-story building to cost $975,000, which Mr. Andrew Carnegie is to present to the Associated Societies of Engineers of New York. It is to be erected on the large plot from 25 to 33 West Thirty-ninth Street, and immediately adjoining it in the rear, facing at 32 and 34 West Fortieth Street, will be a thirteen-story club-house, which is to cost an additional $375,000, also part of Mr. Carnegie's gift.

M. Emmanuel Drake del Castillo has bequeathed to the Paris Natural History Museum a herbarium, a botanical library and the sum of $5,000.

The London *Times* says that an offer has been made by certain of the companies engaged in the production of phonographic records to deposit in the British Museum

records of the voices of distinguished living men, and that the trustees have expressed their willingness to receive, under special restrictions and with very careful selection, such records, which will be for posterity only and will in no circumstances be available for contemporary use.

A geological excursion to Syracuse, N. Y., for the purpose of examining the glacial-marginal channels, first explained by Gilbert and later more fully described by Fairchild, was made on April 15–17; professors and students to the number of twenty-five from six institutions, Harvard, Colgate, Syracuse, Cornell, Rochester and Rutgers, participating. Professors Davis, Hopkins, Fairchild and Lewis were present. The weather was inclement, high wind with snow squalls blowing cold all three days; but the channels were of repaying interest. They were examined in three north-sloping spurs of the upland or plateau country, and found to recur repeatedly in systematic sequence; but the deltas expectably associated with them in the intermediate valleys seemed to be deficient in volume, as if much reduced by subsequent erosion.

It is stated in *Nature* that the president of the Board of Agriculture and Fisheries has appointed a departmental committee to inquire, by means of experimental investigation and otherwise, into the pathology and etiology of epizootic abortion, and to consider whether any, and, if so, what, preventive and remedial measures may with advantage be adopted with respect to that disease. The chairman of the committee is Professor J. MacFadyean, principal of the Royal Veterinary College.

The Congress on Quackery, which was to have been opened in Paris on May 8 under the presidency of Professor Brouardel, has been postponed till April 30, 1906.

Lieutenant Peary has chartered at St. John's the sealer *Erik* to convey coal and stores to Greenland and act as auxiliary vessel to his projected Arctic expedition.

The Boston Society of Natural History announces subjects for the two annual Walker prizes in 1906 as follows:

An experimental field study in ecology.

A contribution to a knowledge of the nature of competition in plants.

A physiological life history of a single species of plant.

Phylogeny of a group of fossil organisms.

A study in stratigraphy.

A research in mineral physics.

A study on entectics in rock magmas.

A study in river capture.

A region that is new to both geologists and topographers is described by Professor Israel C. Russell in a preliminary report on the geology and water resources of central Oregon, recently published by the United States Geological Survey. No description of the physical features, water resources or geology of this region is in print, and the only map that Professor Russell found available for use during his reconnaissance, which took place in the summer of 1903, was a map of the state of Oregon, drawn to a scale of 12 miles to the inch, published by the General Land Office. The route followed by Professor Russell and his assistants led from Burns, Oregon, westward through the western part of Harney County, across the southeastern and central portions of Crook County, by way of Prineville and Sisters, thence southward through the northwest portion of Klamath County to Fort Klamath, and thence westward across the Cascade Mountains to Medford, in Jackson County. The region examined includes the extreme northern part of the Great Basin (an area of about 210,000 square miles situated principally in Oregon, Nevada, Utah and southeastern California, from which no streams flow to the ocean) and a part of the drainage area of Deschutes River and of its principal tributary, Crooked River, which joins it from the east.

Dr. Joseph Hyde Pratt's annual report to the U. S. Geological Survey on the production of asbestos shows that the principal changes to be noted in the asbestos industry at the close of 1904 were the increase in the production in the United States of the amphibole variety, the development of the Grand Canyon chrysotile asbestos deposits, and the increase in the demand for the chrysotile variety. The many new uses which have been devised for

chrysotile asbestos have created a demand for it that is now in excess of the supply. The high price which can be obtained for the chrysotile asbestos when it is in fibers of sufficent length for spinning permits the mining of this mineral in some places where the cost of mining would become prohibitory with any material decrease in price. One of the most interesting features of Dr. Pratt's report this year is a description of the results of certain experiments that have been made on asbestos building board by Mr. George F. Sever, of New York City, for the Keasbey and Mattison Company, of the same city. The tests were made on asbestos building lumber and magnesia building lumber and show conclusively that both these materials are superior to wood for the purposes for which they are manufactured, but that the asbestos lumber is much better than the magnesia. Such asbestos lumber, when employed in the construction of street railway and standard railway cars, for covering the end framing, should prevent the cars from taking fire by any derangement of the electrical apparatus. Another type of asbestos building material that is beginning to be extensively used is asbestos board or sheathing, for roofing and for side walls. An asbestos shingle recently patented by Messrs. Keasbey and Mattison is composed of asbestos fiber and hydraulic cement. These shingles are much stronger than slate and lighter in weight. They are made in three colors, gray, slate and tile red, in squares 4½ inches on a side, with two corners of the square truncated. The use of asbestos materials in building has been considered chiefly from the standpoint of fireproofing; yet there is another and perhaps as important a reason for their employment, and that is for preserving an even temperature in the building erected. Houses so built as to be surrounded by asbestos should be cooler in summer and warmer in winter than other houses.

UNIVERSITY AND EDUCATIONAL NEWS.

THE McCormick family have added $1,000,000 to the endowment of the McCormick Theological Seminary of Chicago.

MR. ANDREW CARNEGIE has offered to give Radcliffe College $75,000 for a library building on condition that an equal sum be collected for its endowment.

LORD CURZON has laid the foundation stone of the Agricultural College at Pusa. This college and experiment station were made possible by a gift of $150,000 which Mr. Henry Phipps gave Lord Curzon to use for the good of the people of India.

BIRMINGHAM UNIVERSITY has received £20,000 under the will of the late Mr. Thomas Best.

THE Boston *Transcript* reports that the faculty of the Massachusetts Institute of Technology has adopted by a vote of fifty-seven to six a report adverse to the proposed alliance with Harvard University.

DR. JULIUS STIEGLITZ, of the department of chemistry of the University of Chicago, has been appointed to a professorship of chemistry in that institution.

AT the University of Colorado, Dr. M. E. Miles, who has been demonstrator of anatomy, has been appointed professor of anatomy; Dr. E. H. Robertson, professor of bacteriology and pathology, has resigned to engage in other work; and Mr. G. S. Dodds has been appointed instructor in zoology.

MR. WILLIAM E. BROOKE has been promoted to an assistant professorship of engineering mathematics in the University of Minnesota.

DR. J. CARLTON BELL has been appointed instructor in experimental psychology in Wellesley College.

MR. STANLEY DUNKERLEY, M.Sc., head of the department of applied mathematics in the Royal Naval College, Greenwich, has been appointed professor of engineering in the University of Manchester.

AT King's College, London, Mr. Peter Thompson, M.D., has been elected professor of anatomy; and Professor Arthur Dendy, D.Sc., South African College, Cape Town, has been elected professor of zoology.